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Atty. Docket No: D-4557

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the (x) utility, () design, ()
plant patent application of:

INVENTOR: Rachel Learned

FOR: **SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY
MODULATED SIGNALS**

Enclosed are:

- (x) 27 pages of specification (X) Abstract
(x) Oath or Declaration (X) Power of Attorney
(x) 4 pages of (x) Formal () Informal Drawings.

(x) An assignment of the application to: **BAE SYSTEMS Information and Electronic
Systems Integration, Inc.**

- () Preliminary Amendment () Information Disclosure
() Oath or Declaration Statement
() Associate Power of Attorney () Power of Attorney
() Verified Statement under 37 CFR 1.9 and 1.27 claiming small entity
() Petition for One-Month Extension of Time

The filing fee is calculated as follows:

FOR	NUMBER FILED	NUMBER EXTRA	CLAIMS AS FILED		AMOUNT
			RATE		
			LARGE	SMALL	
BASIC FEE					
Utility	xxxxxx	xxxxxx	\$710.00	\$355.00	\$ 710.00
Design	xxxxxx	xxxxxx	\$320.00	\$160.00	\$ 00.00
Plant	xxxxxx	xxxxxx	\$490.00	\$245.00	\$ 00.00
Total Claims	10 - 20	- -	0 x \$18.00	x \$ 9.00	\$ 00.00
Independent Claims	2 - 3	---	0 x \$80.00	x \$ 40.00	\$ 00.00
Multiple Dependency			\$270.00	\$135.00	\$ 00.00

Late Fee Surcharge	\$130.00	\$ 65.00	\$ 00.00
Non-English Language Fee	\$130.00		\$ 00.00
Assignment Recording Fee	\$ 40.00	\$ 40.00	\$ 40.00
TOTAL			\$750.00

() A check in the amount of \$355.00 to cover the filing fee is enclosed.

() A check in the amount of \$40.00 to cover the cost of the Assignment Recording Fee is enclosed.

() This application is filed under the provisions of 37 CFR 1.53, and does not include:

- () Oath or Declaration
- () Filing Fee

(X) The Commissioner is hereby authorized to charge payment of the following fees or credit any overpayment to Deposit Account No. 19-0130. A duplicate copy of this sheet is enclosed.

- (x) Any additional filing fees required under 37 CFR 1.16
- (x) Any patent application processing fees under 37 CFR 1.17
- (x) The Issue Fee set in 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b)

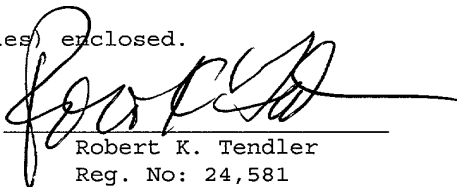
() Priority is claimed under 35 USC 119 based on the following:

Serial No.	Date Filed	Country
_____	_____	_____
_____	_____	_____

() Certified copy (copies) enclosed.

Date: _____

8/31/01



Robert K. Tendler
Reg. No: 24,581
65 Atlantic Avenue
Boston, MA 02110
(617) 723-7268
(617) 723-7186

ADDRESS:

TELEPHONE:

FAX:

D-4557

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: **Rachel E. Learned**

Express Mail Label No:

EL797751741US

Date of Deposit: 8/31/01

Filed: On Even Date Herewith

For: **SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING
DIGITALLY MODULATED SIGNALS**

PATENT APPLICATION AND
CERTIFICATE OF MAILING

Honorable Commissioner
U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

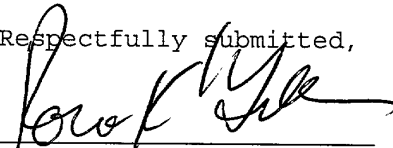
Pursuant to the provisions of 35 U.S.C. 21(a) as amended by Public Law 97-247 and 37 C.F.R. 1.10, the above-identified Applicant encloses for filing the attached Patent Application entitled **SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS**. This application includes 27 sheets of specification, 4 sheets of formal drawings and authorization to charge account number 19-0130 in the amount of \$710.00 and \$40 to cover the Assignment Recording Fee. This Application is being filed on 8/31/01 by mailing an application to Commissioner of Patents and Trademarks, Box New Applications, Washington D.C. 20231, via the United States Postal Service under 37 C.F.R. 1.10. The Express Mail Label number

appears in the heading of this paper which is attached to the Application papers pursuant to 37 C.F.R. 1.10(b).

All correspondence concerning this Application should be sent to:

Robert K. Tendler
65 Atlantic Avenue
Boston, MA 02110
(617) 723-7268

Respectfully submitted,


Robert K. Tendler
Reg. No. 24,581

65 Atlantic Avenue
Boston, MA 02110

Date: 8/31/01

CERTIFICATE OF MAILING

"Express Mail" Mailing Label No: EL797751741US

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I hereby certify that this paper, fee and attachments are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Box New Applications, Washington D.C. 20231.

Dated: 8/31/01


Robert K. Tendler

APPLICATION FOR LETTERS PATENT

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT Rachel E. Learned, a citizen of the United States of America, having a residence at 9 Wimbledon Circle, Waltham, Massachusetts 02451, has invented a certain new and useful SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS.

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TITLE OF INVENTION

SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS

FIELD OF INVENTION

This invention relates to telecommunication and more particularly to a method and apparatus for separating interfering signals utilizing improved parameter estimation techniques.

BACKGROUND OF THE INVENTION

As described in co-pending provisional Patent Application Serial Number 60/233,870 filed on September 20, 2000 by Rachel Learned and Joseph Su, and incorporated herein by reference, a system is provided for separating interfering signals which utilizes a parameter estimation unit. The purpose of the parameter estimation unit is to be able to derive channel parameters which uniquely distinguish the characteristics of each individual signal regardless of the fact that the signals exist in the same communications bandwidth and at the same instant in time. These parameters are required by any signal separation system for highly loaded or overloaded systems of users and in general include for each signal the channel transfer function comprised of the received power, the phase of the oscillator which generated each received signal, the timing offset relative to the base station clock, any frequency offset of the carrier, and the structure of the multipath replicas.

In reality, however, the received power of the signals vary substantially from burst to burst, which means that the parameter estimation becomes somewhat difficult. Likewise, the

phase of the oscillator can also vary from burst to burst, as can the timing offset which is the variance of when the signals are to be received in a particular timing slot of the communications system. Not only can all of these parameters change on a burst by burst basis, the frequency of the carrier can also change, most notably due to Doppler shifts.

The result is that signal separation becomes increasingly difficult in the changing environment where a number of mobile users are trying to communicate with a base station on the same channel.

While the parameter estimation method described in the aforementioned patent application is useful in signal separation, one of its features is that it requires a serial approach to generation of parameter estimation values which overlooks the dynamic nature of the communications environment. In reality, while such a system is able to extract the various parameters of the simultaneously-occurring signals in a quite robust fashion, there remains nonetheless certain times when due to the serial nature of the calculation, there are blanks or blackout periods at which time some of the simultaneously-occurring signals are being ignored or are not being tracked.

For multi-user detection systems, there is therefore a need to be able to dynamically adapt to the changing signals occasioned by the fact that the mobile users are in fact mobile and to the fact that the power adjustment for each of the mobile terminals is adjusted by the base station, sometimes on a burst by burst basis. It will be appreciated that in many multi-user configurations such as with air interfaces including GSM, other TDMA systems and CDMA systems, power level adjustments are made as often as 800 times a second. The result is that a parameter estimation at one particular point in time is invalid if for no other reason than the power level is changed at the handset. While this is done in an organized and routine manner,

when considering overlapping or interfering signals the change in power to say nothing of the other parameters, results in an inability to separate interfering signals on the same channel.

SUMMARY OF THE INVENTION

In order to be able to accommodate multiple interfering signals on the same communication channel in which the signals are purposely allowed to interfere with one another to be able to make maximum utilization of a traffic channel, in the subject invention, initial estimates are made of various parameters utilizing the interference-free received signal on the acquisition channel and the usual traffic channel training sequences which are transmitted to identify each mobile user and to set up timing for the burst transmission from the mobile phone. Thereafter, when a first user or comer exists and is assigned a particular traffic channel, initial parameter values from the acquisition channel are utilized in the tracking of the channel transfer function, including power, multipath structure, timing offset and frequency of this first comer or first signal in the traffic channel.

Thereafter, when a second interfering signal exists on the traffic channel, the system recreates the training sequence portion of every signal on the traffic channel prior to the last signal entering, and subtracts this from the training signal portion of the received signal to provide an interference-free signal from which to calculate estimates of the parameters for a newcomer to the channel. The above utilizes the training signal portions of the received signals. What this does in essence is to single out the signal of the newcomer.

Having estimates of the various parameters of the newcomer to the channel and assuming that there are two or more interfering signals on the channel, parallel processing is then utilized to isolate each of the signals assigned to the same channel by utilizing the previously described method of recreating then subtracting training sequence portions of the

signals. A slightly modified version of the parallel processing portion which utilizes cascaded processing steps is also offered in the event parallel processing is not desirable.

The result is that the system can simultaneously track all of the interfering signals in realtime by providing ultra-fast parameter estimation, with these estimated values utilized by the signal separation algorithm.

In operation, it will be appreciated that various procedures in the open literature and in use today may be used to perform the parameter estimation on the interference-free signal created by this process. One method for calculating high quality estimates of the parameters for each active signal in the traffic channel is to note that if a signal sits in the traffic channel for any given period of time and estimations of the parameters are ongoing, a sliding window weighted average of all previously calculated parameters will produce high quality estimates. What this means is that as each burst arrives and the parameter estimation is done on each burst individually, it is now possible to throw out the parameter estimations associated with prior bursts back farther than some predetermined number, and derive an improved estimate by averaging the parameters from proceeding recent bursts. This is in essence equivalent to a sliding window average in which one can weight the more recent estimates more heavily than those in the past.

The result is that while the system can estimate parameters on a burst by burst basis, more robust parameter estimation can be achieved through intelligent averaging.

What is therefore accomplished is the ability to permit signal separation in an environment in which multiple signals interfere with one another and the signals are dynamically changing without suffering blank periods or interruption in the parameter estimation process. Blank periods or incorrect values of parameters would lead to the inability

to separate signals for any signal separation or multiuser detection system for recovering each of the interfering users' information bit sequences.

What has been described is the utilization of the acquisition channel and the training sequences which are normally utilized to initialize the handsets and to track timing. There are, of course, many techniques for isolating training sequences, such as zeroing out the signal to either side of the training sequence. This can be done through windowing techniques or by digital signal processing in which actual values corresponding to signals outside the training sequence are replaced by zeros.

The training sequence as used herein refers to any apriori known bit or symbol sequence which is utilized to obtain estimates of the various parameters associated with each of the co-channel transmitted signals. They can be for instance a pilot tone, a particular bit stream or can even be a recovered estimated bit stream which can be assumed to be perfectly known.

As in the case of GSM transmission, the training sequence is utilized to identify each mobile user and to acquire timing offsets so that the base station can send control signals to tell the mobile unit to alter its timing. It will be appreciated that these training signals exist already. Since they exist, the subject system can make use of these training signals to permit rapid parameter estimation.

Thus, for instance in GSM, and other wireless multiple access communication systems, training signals are regularly utilized. It is for this reason that any digital communication system can make use of the subject parameter estimation system so that interfering signals can be separated.

In summary, in a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit is provided which utilizes parallel processing for

determining the channel for each received signal, which, in essence provides for each signal the received power, multipath structure, phase of the oscillator, timing offset relative to the base station clock and carrier frequency offset, with the system providing realtime uninterrupted estimates of these parameters required by the signal separation unit. In one embodiment, the estimated parameters are obtained through first providing estimated power, multipath structure, timing and frequency offset for signals on the acquisition channel. When a user communicates with the base station over the acquisition channel, the base station assigns it a traffic channel. Prior to the signal switching over the traffic channel, the base station estimates power, timing offset and frequency offset. These initial values from the acquisition channel are passed to the tracking unit for the traffic channel. Additionally, for each signal in the traffic channel, phase is also tracked without utilization of the initial set of estimates from the acquisition channel since current systems do not require phase coherent transitioning from the acquisition channel to the traffic channel and therefore would render any phase estimates done in the acquisition channel useless. Of course, if some level of coherence exists between the carrier oscillator phase in the received signal over the acquisition channel and the first instance of the received signal over the traffic channel, then an initial phase estimate can be done in the acquisition channel and passed with all other estimates to the traffic channel parameter tracking unit. When a second signal is detected at the base station and is assigned to the same traffic channel, then the parameter estimation unit recreates the training sequence signal portion of every signal on the traffic channel prior to the last signal entering and subtracts this from the training portion of the received signal which is an aggregate of all the prior signals so as to provide an estimate of the signal solely due to the newcomer to the channel during the training signal portion. This singles out the newcomer and therefore allows for a clean signal from which to estimate parameters of

the newcomer. After a short period of time the parameters will be of high quality with respect

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to the newcomer. Thereafter the system simultaneously tracks all signals in the traffic channel.

In one embodiment, this is accomplished by a parallel recreation of the training signal portions of the traffic channel signals so as to isolate only one user's signal at a time. With five co-channel signals there will be, in one embodiment, five parallel processing blocks each isolating a different signal within the channel.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the subject invention will be better understood in connection with the Detail Description in conjunction with the Drawings of which:

Figure 1 is a diagrammatic representation of the utilization of parameter estimation in the signal separation process in which the parameter estimation provides parameter values respectively for received power, phase, timing offset and carrier frequency offset;

Figure 2 is a block diagram illustrating the first step in the generation of parameter estimation values through the utilization of signals in the acquisition channel and then from the first signal in the corresponding traffic channel;

Figure 3 is a block diagram of the operation of the subject system in which a second interfering signal is assigned to the same traffic channel, in which the subject system utilizes the recreation of the training sequence portion of every signal on the traffic channel prior to the last signal entering and subtracts this from the training sequences; and,

Figure 4 is a block diagram of a parallel tracking scheme for more than one interfering signal in a steady state where no users have dropped in or out of a channel.

DETAILED DESCRIPTION

Referring now to Figure 1, as will be seen, a number of wireless transceivers 10, 12 and 14 communicate with a base station 16 in which the signals from the wireless transceivers 10, 12 and 14 simultaneously exist on the same traffic channel.

It is the purpose of the subject system to permit the separation of these signals which coexist and to do so with a parameter estimation system which provides for realtime signal separation by providing rapidly generated parameters to the signal separation unit.

It will be appreciated that in most digital wireless communication systems a training sequence is transmitted as part of each burst of data for the purpose of enabling the receiver to determine and adjust the timing and other parameters which permit the wireless transceivers to communicate with the base station and visa versa.

In the GSM system, for example, the training sequences are transmitted in the middle of a burst, either traffic, control, signal, etc, so as to provide for appropriate transmissions from the wireless units. The purpose of the training signal is so that each transmitter can be identified relative to the others and so that their transmissions or bursts can be placed in the appropriate time slot for demodulation at the base station, as well as to sort the received data streams for data routing after demodulation and recovery of the bit streams.

The problem with such a system occurs when each of the wireless transmitters transmits on the same channel at the same frequency and at the same time. What this means is that simultaneous signals are arriving at the base station 16, and must be separated in order to be intelligible. Such systems are called overloaded multiple access systems and require for signal separation certain parameters of each of the signals which distinguish them. Presently, overloaded systems are not among those in operation due to the lack of reliable robust signal

separation devices, partly due to the lack of a reliable robust parameter estimation device able to estimate and track signal parameters when the signals are interfering with one another.

As illustrated at 20, a parameter estimation unit is to provide the channel transfer function for each of the interfering users at its output. In the remainder of this description, the parameters that will be required for signal separation are delineated and specified in place of the more general notion of the channel transfer function, although knowing the channel transfer function is equivalent to knowing these parameters. Specifically the parameter estimation unit 20 provides at its output for each interfering user the received power 22, the phase 24 of the oscillator for each of the transmitted signals, the timing offset 26 relative to the base station clock and transmission distance, the carrier frequency offset 28 and the multipath structure 29. Each of the signals in the particular traffic channel here labeled $S_1, S_2, S_3 \dots S_n$ are identified in realtime as to their various parameters. These parameters, when identified, are utilized in the signal separation process such as described in the aforementioned patent application, assigned to the assignee hereof.

As mentioned hereinbefore, multi-path and Doppler shifts caused by the movement of the wireless transmitter and due to the constantly changing power levels associated with the basic transmission itself, require that the parameter estimation unit track all of these changes so that the values outputted by the parameter estimation unit reflect what is happening in a real world scenario and do so in realtime. Thus the parameter estimation system must be able to operate in a robust realtime manner so that neither blanks nor lack of accurate parameters values exist.

Referring now to Figure 2, in one embodiment, signals in the acquisition channel are utilized first to provide an initial set of estimated power, timing offset and frequency offset values.

Taking for instance a wireless transceiver 30, it communicates over acquisition channel 32 to base station 16 which through techniques that are known, provides an initial set of estimates of estimated power 34, timing offset 36, frequency offset 38, and multipath structure 39 for the first wireless user which seeks to communicate with the base station.

It is the purpose of the initial estimation process to be able to track the first comer or first signal in a traffic channel which is assigned by the base station 16.

After communicating over acquisition channel 32, wireless transceiver 30 is assigned to a particular traffic channel, here illustrated at 40. Then the first signal which exists in this traffic channel and received by base station 16 has its power, timing offset, carrier frequency offset, and multipath structure tracked utilizing the initial values which were generated by analysis of the signal in the acquisition channel. Here the initial values are applied to a power tracking algorithm 42, a timing offset tracking algorithm 44, a frequency tracking algorithm 46, and a multipath structure tracking algorithm 49 the outputs of which are parameters corresponding to the tracking of this particular signal.

Also included is a unit 48, which estimates and tracks the relative phase of the first signal of the traffic channel 40. Note that power tracking, timing offset tracking, phase tracking and multipath structure tracking may be done conventionally as described in "Spread Spectrum Communications Handbook", Simon, Omura, Scholtz and Lebatt, McGraw Hill, Inc. 1994, or in any other manner described in the open literature including methods of estimating and/or tracking the entire channel transfer function from a known transmitted signal where the separate

estimation of the power, timing offset, phase, frequency offset, and multipath structure is not necessary. The outputs, here designated 50, correspond to the parameter values for the first signal in the channel.

Referring now to Figure 3, the use of a training signal is described. A wireless transmitter 30 now communicates with the base station 16 over traffic channel 40. Current estimates of power, timing offset, frequency offset, phase, and multipath structure corresponding to the received signal due to transmitter 30 are tracked and are available over line 50. A second comer or wireless transmitter 52 simultaneously communicates with base station 16. Note that initial parameter estimates have been calculated at 39. It is assumed that in all cases known training sequences have been assigned to the two wireless transceivers. These training sequences are stored as illustrated at 54 as a training protocol in base station 16. Then from these training sequences and the analysis thereof, one can isolate the second signal in order to provide its particular parameter estimates.

How this is done is as follows: The signals from the first comer 30 and the second comer 52 simultaneously exist on channel 40 at base station 16. Both wireless transceivers 30 and 52 simultaneously transmit training sequences back to base station 16 during a portion of each burst. As illustrated at 60, a unit is provided which recreates the training sequence portions of every signal on the traffic channel prior to the last signal entering the traffic channel, using the most recent parameter estimates 50. In the figure, the signal already on the channel is due to transmitter 30. Hence this signal will be recreated by unit 60. The newcomer signal is due to transmitter 52 for which no high quality parameter estimates yet exist. Hence the signal due to transmitter 52 is not recreated in unit 60.

Unit 60 outputs over 70 the recreated training sequence portion of the received signal 76 that exists due to all signals utilizing the traffic channel 40 prior to the newcomer. If there were more than one transmitter already assigned to the channel 40 prior to the newcomer 52, then the signal due to each of those established users would be recreated and added together to create an estimate of what would have been received if only those established users were transmitting on channel 40 in the absence of the newcomer 52. Unit 60 has knowledge of the timing offsets of all established users and uses this to ensure that the signal sent out over line 70 is perfectly aligned with the measured signals discussed below.

The signal received and measured at the base station 16 which consists of the aggregate of each of the established signals plus the signal due to the newcomer assigned to the same traffic channel 40 is passed over line 73 to windowing unit 74. The function of windowing unit 74 is illustrated diagrammatically at 62 in which the received signal coinciding with the training sequence 64 is allowed to exist, whereas the received signal to either side of the training sequence is nulled or zeroed out, in one embodiment by simply replacing the measured digital values with zeroes for sample points that fall outside the time block known to contain a training sequence. Note that the output of windowing unit 74 is applied to a summing junction 72 as illustrated over unit 75.

The recreated time aligned output signal from unit 60, also having a zeroed out portion corresponding to where data, e.g. unknown bits, would be is delivered over line 70 to summing junction 72. It is the purpose of this summing junction to be able to recreate training sequence portion of every signal communicating on channel 40 prior to the last signal entering from the training sequence portion of the received signal and subtract it away from the received signal that includes all of those estimated plus the signal due to the newcomer. The output 78 of the

summing junction is an estimate of the received signal due only to the newcomer to the channel during the training signal portion. This singles out an interference-free signal for the newcomer such that tracking of power at 80, timing offset at 82, frequency offset at 84, carrier phase at 86 and other parameters such as multipath structure 88 can be done in the manner described above for the first signal on the traffic channel.

After a short period of time, the parameters associated with the newest signal to utilize the traffic channel will have been estimated with high accuracy. Once the newcomer's parameters have been estimated to a satisfactory level of accuracy, this newcomer is considered to be established on the channel. Between the time the most recent newcomer has been established and when the next newcomer arrives, parameters for all established users are tracked. As shown in Figure 4, in the subject system parallel processing techniques are utilized such that each signal sharing the same traffic channel is isolated and the parameter tracking process is continued. This is done in parallel where one processing unit can be assigned to focus on each signal by recreating the training sequence portion of every signal in the traffic channel except the one of interest to that particular processing unit.

Referring now to Figure 4, in order to accommodate a parallel tracking of the interfering signals, assuming that the training sequences are known for these signals and one has initial estimates of all of the signal parameters such as of course, power, frequency offset, timing offset, and multipath structure, then these parameters can be updated by recalculating parameters associated with the first signal by using the information available from the second and third signals. The reason for the updating is that the parameters change in time.

What will be first described is the serial updating scheme in which the parameter tracking unit of Figure 3, which include all of the elements and dotted box 90, are duplicated as 90, 90' and 90".

In operation, assuming one wishes to update the parameters for the first signal, then the outputs of parameter tracking unit 90' and parameter tracking unit 90" are fed back to parameter tracking unit 90 so as to be able to recreate Signal 2 and Signal 3 and then strip them away from the received signal. As described above for the parameter estimation of the newcomer, tracking unit 90 temporarily treats Signal 1 as if it is the newcomer to create an estimate of the received signal that would have been due to the transmission of Transmitter 1. Having thus calculated an interference free signal, the parameter estimates are calculated again as shown in Figure 3 and averaged with older parameter estimates for this user as described in the Figure 3 discussion above.

What this does in a serial fashion is to update the parameters for the first signal with the current parameters for the remaining signals.

While the above has indicated a serial processing scheme, it will of course be appreciated that all of the parallel parameter tracking can in fact be done in a parallel manner, as Figure 4 indicates. What this means is the most recent outputs of a given parameter tracking unit can be made instantly made available to all of the other parameter tracking units such that the calculations rather than waiting for the entire serial process to be completed now operate on current information on a frame by frame basis as possible.

Hence, if there are three signals on the same traffic channel, there are three processing units, one for each signal, all operating simultaneously. The output of each unit is the most current set of parameter estimates for that signal. These estimates are passed, not only to the

signal separation unit, but to each of the other processing units so that the most current information is used when re-creating the training sequence portion of the received signal due to the other two signals.

What is therefore provided is a parallel processing system in which after initial parameters are provided via detection of the acquisition channel, other signals in the channel can be isolated without interruption or having to have a blank period, thus to be able to provide a parameter estimation method or unit which can satisfy the requirements of the upstream signal separation process and provide a realtime update which is accurate and robust as to the parameter values. This permits the signal separation to occur on a seamless basis.

MULTI-USER DETECTION

By way of further background, one multi-user detection, MUD, System in which the parameter estimation unit is to operate is now described.

First, in general, the optimal exhaustive search MUD that can be implemented with a Viterbi algorithm (shortest path algorithm) is exponential in complexity per bit decoded, meaning that the number of states per stage, $M^{(nK)}$, is impractically large when n , the Inter-Symbol Interference (ISI) number, times K , the number of users is greater than 12. Thus, in a practical multi-user environment $n \times K$ could easily exceed 24 such that the complexity per bit decoded is many hundreds of gigaflops or floating point operations per bit. The largest handset computational capacity is on the order of megaflops which will not support an exhaustive multi-user search signal separator like that in Verdu, Chapter 4. The multi-used detection system reduces n by tail chopping. As to K , a grouping of signals based on power reduces K into two

or more sub groups, with which each subgroup containing no more than k users, and for which $n \times K$ is not excessive.

Second, all previously proposed methods to reduce complexity either require that one design new waveforms that will deviate from existing specifications for existing and upcoming wireless systems, or allow ad-hoc interference as long as the interfering waveforms comprise a linearly independent set. The requirement of linearly independent waveforms does not hold if one were to over-pack a GSM cellular timeslot in a single cell or an ACES satellite timeslot in a single spot beam, for example.

The multi-user detection system for which the subject parameter estimation unit is employed does not require the design of new waveforms and does not require the use of a linearly independent set in order to achieve over-packing for existing and proposed systems employing orthogonal signaling. Prior to this system, such a method of over-packing would require the use of the computationally impractical exhaustive search optimal MUD detailed in the Verdu text.

The exponential complexity problem has been solved by improving the theoretical insights corresponding to multi-user detection for asynchronous linearly dependent signals with intersymbol interference to eliminate this impractical complexity.

The primary reason to reduce complexity is so that real time operation is possible with state of the art processors that can be inserted into current base stations, user phones, and other transmit/receive devices that may wish to employ the subject system.

Furthermore, the user phone or small device can tolerate only small increases in complexity relative to what a base station can tolerate. The present invention involves a way to

pack existing signals into the available bandwidth in such a way as to allow for a MUD procedure that is as computationally simple. The subject small device receiver algorithm is as computationally simple as a state of the art receiver and can be accomplished in real time within present state of the art processing for handsets.

In one embodiment, the system consists of the following five core pieces:

1. An asynchronous over-packing scheme for channels in the reverse link (mobile to base, or small computing device typically associated with the user to big computing device typically associated with a controller).
2. A parameter estimation block that proceeds the signal separation block.
3. A signal separation block for the controller (e.g. in the base station receiver) that outputs the channel bits to be processed by the existing system elements such as de-interleaving and error correction decoding.
4. A synchronous packing scheme for the forward link (base to mobile or big device to little device).
5. A signal separation block for the user's device (e.g. mobile telephone) that outputs the channel bits to be processed by the existing system elements such as de-interleaving and error correction decoding.

A sixth power control scheme may be used for improving the bit error rate both on the forward and reverse links.

The packing scheme for reverse link channel is very simple. The controller simply assigns one or more users to the exact same channel. Thus, in a GSM system, the base station

controller would assign all empty time slots to active users. If a new user requests a time slot, the controller assigns a time slot that is already occupied.

The parameter estimation block which is improved by the subject techniques calculates estimates of each user's received power, baud timing offset, frequency offset, and oscillator phase. The controller, during acquisition with a new user, sends the received acquisition signal to the preliminary parameter estimation sub-block which computes maximum likelihood estimates for received power, baud timing offset, frequency offset, and oscillator phase. This information is then conveyed to the parameter refinement sub-block which refines the estimates of these parameters for the new user as well as the existing user or users in the shared time slot.

The signal separation block consists of an algorithm which automatically alternates between two modes of operation within the receiver. It reverts to a simple stripping procedure whenever possible when relative received signal powers are favorable to stripping. Whenever stripping is not capable of giving the required bit error rate, the receiver reverts to an inter-symbol interference (ISI) tail-chopped version of the optimum asynchronous multi-user detector. For more than two users, a hybrid between the ISI chopped optimum multi-user detection and stripping is used.

When the powers of the recovered signals are less than 6dB apart, tail chopping is used to reduce computational complexity. The stripping procedure has the lowest complexity of all multi-user detection procedures, but suffers from bad bit error rate unless the received powers are greater than 6 dB apart in which the highest power signal dominates.

The inter-symbol interference tail-chopped exhaustive search is an improvement over the optimal exhaustive MUD detailed in the Verdu text, and achieves a substantial reduction in complexity by reducing the number of states per stage in the Viterbi decoder used for finding

the maximum likelihood joint sequence. It does so by ignoring the presence of inter-symbol interference tails in the formulation of the optimum exhaustive search MUD.

For two or more users packed within the same channel, the grouped hybrid method is employed. This method groups signals into families according to their received power. In one embodiment, the lowest power signal in one family must be 6 dB higher than the highest power signal in the next lowest power family. The ISI-chopped exhaustive search MUD is performed on one family at a time, starting with the highest power family and working down in power order. After a bit stream is produced for each user in that family, the received signals are recreated using the entire signature pulse for each user in that family without the ISI tails chopped. This recreated interference signal is then subtracted from the original received signal to create an interference-reduced signal. Note, that prior to recreation of the interference signal, the bit streams may be corrected by applying the appropriate error correction if feasible. The above MUD-remod-strip procedure is repeated until all signal families are detected and/or decoded. This block requires all parameters estimated in the parameter block, along with the total number of users sharing each channel.

As to tail chopping, tail chopping merely requires providing the replica of a user's signature pulse without tails to the extensive search multi-user detector. Note that when constructing the trellis (Viterbi decoder) that performs the exhaustive search to determine the optimal set of bit streams associated with the received signal comprised of the aggregate of a number of interfering signals, one must provide a replica of each user's signature pulse, and it is this signature pulse which is provided with tails removed to the Viterbi decoder.

When one provides the complete pulse over its entire non-zero duration, which is typically more than 6 bit durations for K interfering signals, the resulting Viterbi decoder will

have $M^{(Kn)}$ states per stage, where M corresponds to M -ary modulation (e.g. $M=2$ is binary phase shift keying), K is the number of interfering users, and n is the ISI number (e.g. the number of bit durations for which the signature pulse is non-zero).

The computational complexity required for the Viterbi decoder to search all possible paths corresponding to all possible bit combinations is proportional to the number $M^{(Kn)}$ which is the number of states per stage of the trellis.

In order realize a significant reduction in computation required per bit, in the subject invention, a tail-chopped version of each user's signature pulse is provided to the exhaustive search multi-user detector. In the case where one chooses to set the pulse to zero beyond the r th bit duration, where $r < n$, one now has an exhaustive search via a Viterbi decoder with a reduced number of states per stage in the trellis, namely $M^{(Kr)}$.

When the user signals are being received with similar powers, this tail chopping causes negligible degradation in the performance of the, now suboptimal, exhaustive search multi-user detector, but provides the desired bit streams with a significantly lower complexity.

In the case where the received signals are separated by a larger power difference, such as 6-7dB, the error rate in the bit stream associated with the lower power user is significantly degraded by using the tail-chopped version of the exhaustive search multi-user detector.

To solve this degradation problem, the subject invention uses a power ordered stripping technique. When the power separation between highest power signal and the remaining signals is greater than 6dB then the highest power signal is stripped off with a full tail, with lower power signals having tails chopped in the formulation of the Viterbi-decoder-based search to eliminate complexity that these tails cause in the optimal signal separation process.

Thus, in the more general case of making use of stripping to reduce the complexity consider to the case where any two power-adjacent received signals are separated by a large amount, e.g. 6 dB. In this case one reduces the complexity by stripping off the group of higher power signals, thus reducing the number, K , of interfering users expected by the exhaustive search multi-user detector. Specifically, one tells the exhaustive search multi-user detector that there are only I users, the number of users in the highest power grouping. In effect, one has decided to treat all other users as background noise. Once these users have been decoded, they are recreated with full ISI tails and stripped from the received signal to create an interference-reduced signal, e.g. an estimate of what would have been received if none of the I signals in the highest power grouping were present.

Since the other users are all much lower in received power, e.g. 6 dB lower than the lowest power user in the higher power grouping, this sub-optimal assumption causes negligible degradation to the bit error rates of the users in the high power grouping.

The benefit of tail chopping and iteratively stripping off users is that the computational complexity required is at least an order of magnitude lower since the complexity required is only on the order of $M^{(Ir)}$ computations per bit decoded. This is significantly smaller than $M^{(Kn)}$ since $I < K$ and $r < n$.

Once the decoded bits associated with the I users in the highest power grouping have been decoded, the signals are reconstructed using the full signal with the full tails covering n bit durations and the reconstructed full signals are subtracted from the received signal. One now has an estimate of the received signal that does not include the I users in the highest power grouping. The process is then iterated, detecting and stripping off the next highest power group of signals until there are no more signals left.

In one embodiment, the power grouping is done by the parameter estimation block. The parameter estimation block must determine each user's power as part of its function. It then orders the users by power. Once ordered, the users are grouped together according to power families for which there must be a large power difference, e.g. 6dB, between the lowest power user in one family and the highest power user in the next lower power family.

If there are only a total of two users, then the power grouping would either separate the two users in to two "groups" if there was 6dB or greater difference between them, or group them together in one grouping if there was not.

As to the forward link, the subject synchronous packing scheme for the forward link allows for a simple signal separation procedure in the user device. Here, the subject system takes the ability to perform an orderly signal packing in the controller prior to sending the signal out to the forward channel. This is useful in that any timing or phase offsets are known by the handset prior to parameter estimation.

Note that, the separation algorithm block within the user device may be same as that in a base station.

As a further improvement a power control scheme can be implemented to control the power at the handsets to provide for groups of received signals based on power levels to permit more rapid processing by, in effect, reducing K into sub-groups of smaller k 's.

The primary benefit of supersaturated communications is a significant increase in the throughput of existing cellular, PCS, and satellite multiple access communication systems, as well as systems currently being designed for future use such as next generation cellular, local wireless loop, and wireless local area networks for wireless internetworking of devices or appliances.

Having now described a few embodiments of the invention, and some modifications and variations thereto, it should be apparent to those skilled in the art that the foregoing is merely illustrative and not limiting, having been presented by the way of example only. Numerous modifications and other embodiments are within the scope of one of ordinary skill in the art and are contemplated as falling within the scope of the invention as limited only by the appended claims and equivalents thereto.

0994370-033101

WHAT IS CLAIMED IS:

1. A method for providing parameter estimation for multi-user detection systems in which the received signals are provided with training sequences, comprising the steps of:

detecting the channel characteristics from a first received signal and deriving parameter estimations for the first signal therefrom;

using the parameter estimations associated with the first signal in combination with the training sequence of the first signal to recreate a signal only due to the first signal; and

subtracting out the recreated first signal from the total received to obtain all parameters needed for the second signal using traditional parameter estimation techniques.

2. In a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit for use in conjunction with a signal separation unit, comprising:

a signal processor for determining the channel transfer functions for each received signal;

and,

means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis.

3. The parameter estimation unit of Claim 2, wherein said multi-user detection system includes a base station with a base station clock having a clock frequency offset, and wherein said channel transfer function parameters include for each received signal at least one of received power, oscillator phase of the oscillator used to produce an interfering signal, timing offset relative to the base station clock frequency offset, number of multi-path replicas and delays for each replica.

4. The parameter estimation unit of Claim 3, wherein the estimated parameters are obtained by first deriving the estimated channel function for each interfering signal.

5. The parameter estimation unit of Claim 2, wherein the multi-user detection system includes providing an acquisition channel, and wherein the first derived estimated channel transfer function is derived from acquisition channel parameters.

6. The parameter estimation unit of Claim 2, wherein said multi-user detection system includes a tracking unit for acquired signals, and wherein in the presence of a new signal in the acquisition channel said parameter estimation unit estimates the channel transfer function prior to signal switching from the acquisition channel to the traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter.

7. The parameter estimation unit of Claim 6, wherein for said traffic channel phase is tracked without utilization of the estimates from the acquisition channel.

8. The parameter estimation unit of Claim 7, wherein all received signals have training portions, and wherein for a second interfering signal detected by said base station and assigned to said traffic channel, said parameter estimation unit recreates the training signal portion of every received signal prior to the last received signal and subtracts the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

9. The parameter estimation unit of Claim 2, wherein after initial estimate generation, said multi-user detection system simultaneously tracks all signals in said traffic channel.

10. The parameter estimation unit of Claim 9, wherein said simultaneous tracking includes blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel.

094370-02E4560

ABSTRACT

In a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit is provided which utilizes signal processing for determining the channel transfer function for each received signal, including the received power, phase of the oscillator, timing offset relative to the base station clock carrier frequency offset, and number of multipaths replicas and delays for each replica, with the system providing realtime uninterrupted estimates of these parameters required by the signal separation unit.

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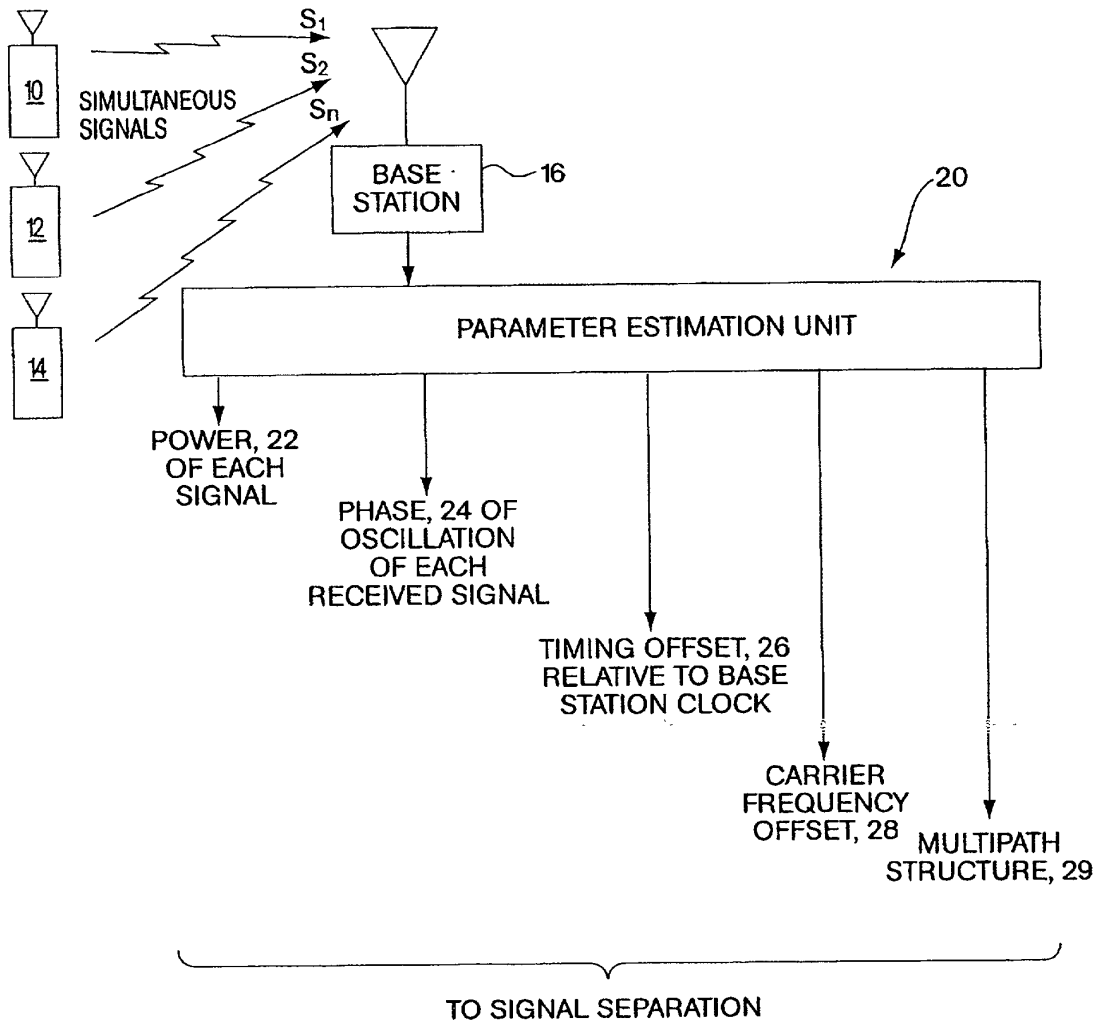


Fig. 1

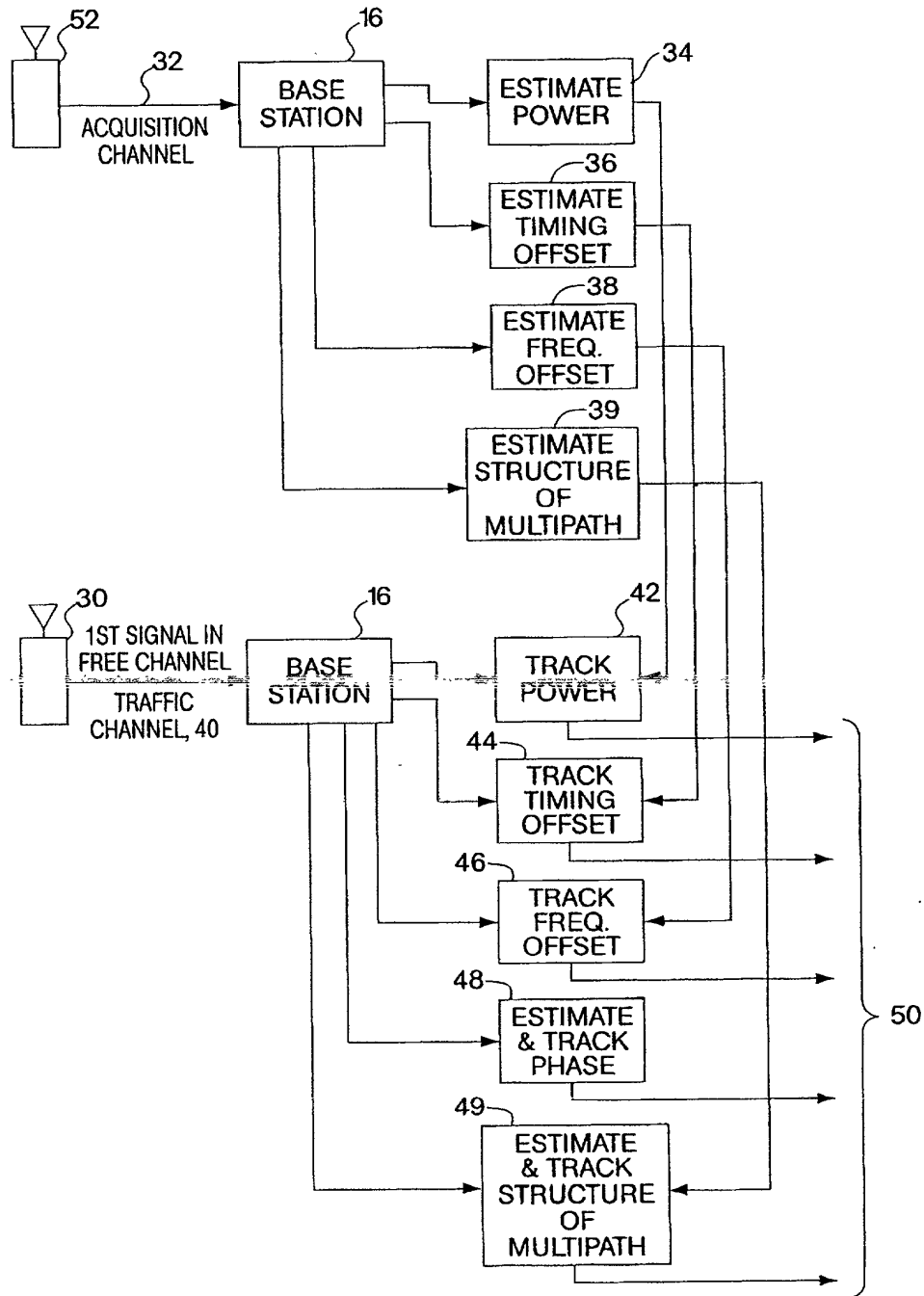


Fig. 2

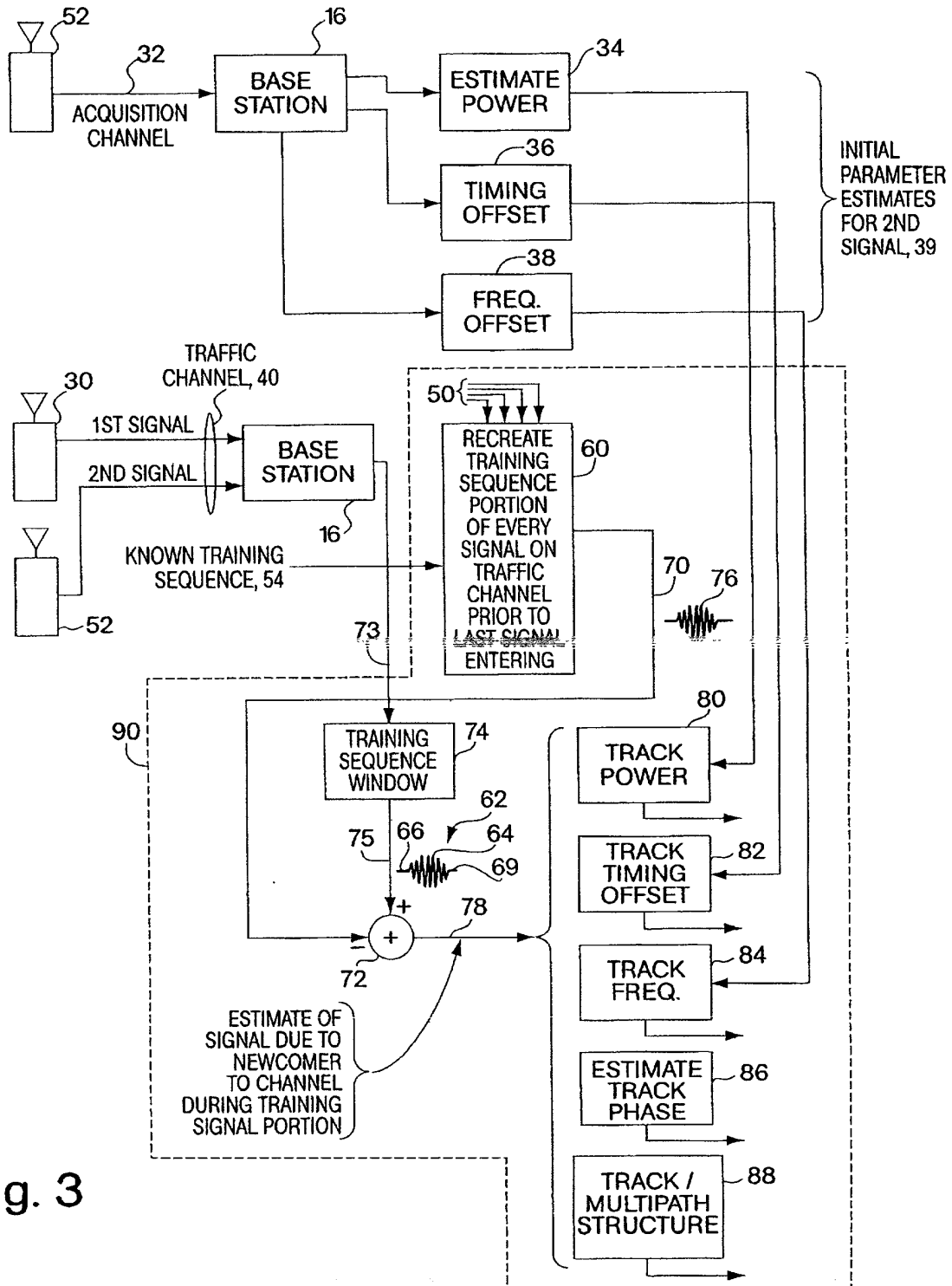


Fig. 3

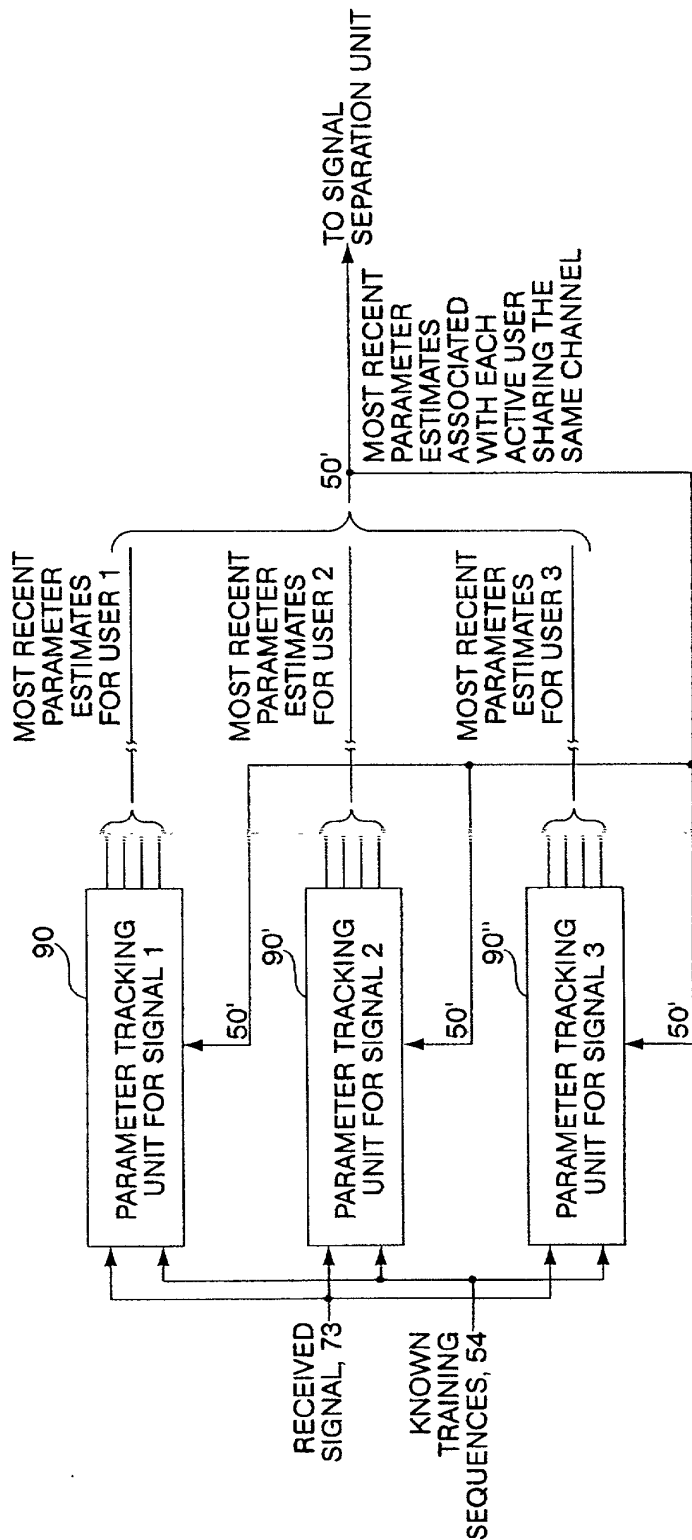


Fig. 4

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS
the specification of which

(check one) ☒ [X] is attached hereto
☐ [] was filed on _____ as Application Serial No: _____
 and was amended on (if applicable) _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a) - (d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
_____ (NUMBER)	_____ (COUNTRY)	_____ (DAY/MONTH/YEAR FILED)	☐ [] YES	☐ [] NO
_____ (NUMBER)	_____ (COUNTRY)	_____ (DAY/MONTH/YEAR FILED)	☐ [] YES	☐ [] NO

I hereby claim that the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT International application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

_____ (APPLICATION SERIAL NO.)	_____ (FILING DATE)	_____ (STATUS) (PATENTED, PENDING, ABANDONED)
_____ (APPLICATION SERIAL NO.)	_____ (FILING DATE)	_____ (STATUS) (PATENTED, PENDING, ABANDONED)

If more space is needed for any of the above categories, please continue on an additional form and SIGN.

I HEREBY APPOINT THE FOLLOWING AS MY ATTORNEY OR AGENT(S) WITH FULL POWER OF SUBSTITUTION TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT OFFICE CONNECTED THEREWITH:

Name	Reg. No.	Name	Reg. No.	Name	Reg. No.
Robert K. Tendler	24,581				

SEND CORRESPONDENCE TO:

NAME	PHONE NO.	STREET	CITY & STATE	ZIP CODE
Robert K. Tendler	(617) 723-7268	65 Atlantic Avenue	Boston, MA	02110

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Rachel E. Learned

Inventor's Signature: Rachel E. Learned Date: August 30, 2001

Residence: Waltham, Massachusetts Country of Citizenship: U.S.A.

Mailing Address: 9 Wimbledon Circle Waltham, MA 02451



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Bib Data Sheet

CONFIRMATION NO. 2465

SERIAL NUMBER 09/943,770	FILING DATE 08/31/2001 RULE	CLASS 370	GROUP ART UNIT 2661	ATTORNEY DOCKET NO. D-4557	
APPLICANTS Rachel E. Learned, Waltham, MA; ** CONTINUING DATA ***** THIS APPLN CLAIMS BENEFIT OF 60/233,870 09/20/2000 ** FOREIGN APPLICATIONS *****					
IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 10/04/2001					
Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged _____ Examiner's Signature _____ Initials _____		STATE OR COUNTRY MA	SHEETS DRAWING 4	TOTAL CLAIMS 10	INDEPENDENT CLAIMS 2
ADDRESS Robert K. Tendler 65 Atlantic Avenue Boston ,MA 02110					
TITLE System for parameter estimation and tracking of interfering digitally modulated signals					
FILING FEE RECEIVED 710	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

09/06/2001 AADOF01 00000030 190130 09943770
01 FC:101 710.00 CH

PTO-1556
(5/87)

*U.S. GPO: 1999-459-082/19144

PATENT APPLICATION FEE DETERMINATION RECORD Effective October 1, 2000

Application or Docket Number

D-4557

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	10	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	10 minus 20 =	* 0
INDEPENDENT CLAIMS	2 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT ☐		

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	Min	**
	Independent	Min	***
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐		

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	Min	**
	Independent	Min	***
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐		

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	Min	**
	Independent	Min	***
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐		

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
 ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
 *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
 The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

SMALL ENTITY TYPE ☐

OR OTHER THAN SMALL ENTITY

RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL		OR	TOTAL	710

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RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDI-TIONAL FEE		RATE	ADDI-TIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

CLAIMS ONLY							SERIAL NO. 09943770	FILING DATE					
							APPLICANT(S)						
CLAIMS													
	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT			*		*		*	
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50							100						
TOTAL IND.	2						TOTAL IND.						
TOTAL DEP.	8						TOTAL DEP.						
TOTAL CLAIMS	10						TOTAL CLAIMS						

* MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS

FORM PTO-2022 (1-98)

U.S. DEPARTMENT OF COMMERCE
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2700 INTERNAL TRANSFER REQUEST FOR S.N. 09/943770

USF10

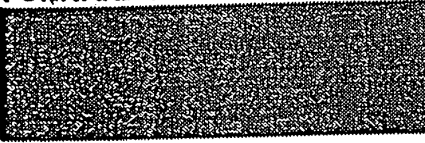
DATE: <u>23 OCT 01</u>	FROM: <u>JOHN PEZZLO</u> (print name)
FORWARD TO: A. Art Unit: <u>2634</u> B. Class: <u>375</u> C Subclass: <u>148</u>	REASON(S): A. You had Parent ☐ (check box) B. See Title ☒ (check box) C. See Abstract ☒ (check box) D. See Claim(s): <u>all</u>

FURTHER EXPLANATION IF NEEDED:

RADIO RECEIVER - BASE STATION
(REDUCE INTERFERENCE)

DATE: _____	FROM: _____ (print name)
FORWARD TO: A. Art Unit: _____ B. Class: _____ C Subclass: _____	REASON(S): A. You had Parent ☐ (check box) B. See Title ☐ (check box) C. See Abstract ☐ (check box) D. See Claim(s): _____

FURTHER EXPLANATION IF NEEDED:

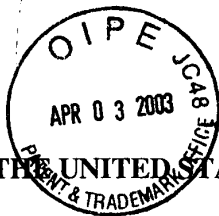
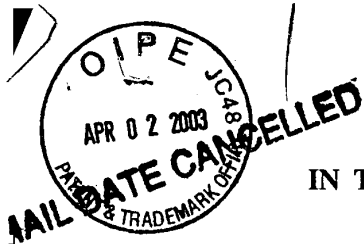
DATE: _____	FROM: _____ (print name)
FORWARD TO CLASSIFIER 	REASON(S): A. You had Parent ☐ (check box) B. See Title ☐ (check box) C. See Abstract ☐ (check box) D. See Claim(s): _____

FURTHER EXPLANATION IF NEEDED:

DISPOSITION BY 2700 CLASSIFICATION

DATE: _____	CLASSIFIER: _____
FORWARD TO: A. Art Unit: _____ B. Class: _____ C Subclass: _____	REASON(S): A. You had Parent ☐ (check box) B. See Title ☐ (check box) C. See Abstract ☐ (check box) D. See Claim(s): _____

FURTHER EXPLANATION IF NEEDED:



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

2634

#2

06-18-03

S-I

In Re Application of: LEARNED, Rachel

Group Art Unit:

Serial No. 09/943,770

Examiner:

Filed: 08/31/2001

Atty. Dkt. No: D-4557 US

For: System For Parameter Estimation & Tracking Of Interfering Digitally Modulated Signals



RECEIVED

APR 07 2003

Technology Center 2600

To: Assistant Commissioner for Patents
Washington, D.C. 20231

Fm:

CERTIFICATE OF MAILING 37 CFR 1.8: I certify that this correspondence is being deposited on the below date with the U.S. Postal Service with sufficient postage as FIRST CLASS MAIL addressed to: Assistant Commissioner of Patents, Washington, DC 20231.

Date: 3-31-03

Gloria Abbasciano

Gloria Abbasciano

Dear Assistant Commissioner:

INFORMATION DISCLOSURE STATEMENT

Applicants submit this statement and the attached 1 sheet(s) of form PTO-1449 and 4 specimens of prior art and other information in accordance to the duty of disclosure under 37 C.F.R. §§1.56, 1.97, and 1.98, and requests consideration hereof.

Compliance with 37 C.F.R. §1.97: This Information Disclosure Statement is filed within three (3) months of the filing date of a National Application or before the mailing date of a first office action on the merits. No fee or certification is required.

Information Cited: The Applicants hereby make of record in the above-identified application, the information listed on the attached form PTO-1449 (modified). The order of presentation of the references should not be construed as an indication of the importance of the reference. As all the references listed on attached Form PTO-1449 are in English, no commentary is required.

Remarks: A copy of each reference, together with a listing on Form PTO-1449(modified), is submitted herewith. Applicants respectfully request that:

1. The Examiner consider completely the cited information, along with any other information, in reaching a determination concerning the patentability of the present claims;

2. The enclosed form PTO-1449 (modified) be signed by the Examiner to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

3. The citations for the information be printed on any patent which issues from this application.

By submitting this Information Disclosure Statement, the Applicants make no representation that a search has been performed, of the extent of any search performed, or that more relevant information does not exist.

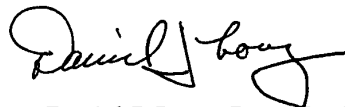
By submitting this Information Disclosure Statement, the Applicants make no representation that the information cited in the Statement is, or is considered to be, material to patentability as defined in 37 C.F.R. §1.56(b).

By submitting this Information Disclosure Statement, the Applicants make no representation that the information cited in the Statement is, or is considered to be, in fact, prior art as defined in 37 C.F.R. §102.

Notwithstanding any statement by the Applicant, the Examiner is urged to form his own conclusion regarding the relevance of the cited information.

An early and favorable action is hereby requested.

Respectfully submitted,



Daniel J. Long, Reg. No. 29,404

PTO Cus. No. 22500
BAE SYSTEMS
PO Box 868, NHQ01-719
Nashua, NH 03061-0868
Tel. No. (603) 885-2643
Fax. No. (603) 885-2167
Email: Daniel.j.long@baesystems.com

Form PTO-1449				Complete if Known	
				Application Number	09/943,770
				Filing Date	8/31/01
				First Named Inventor	LEARNED, Rachel
				Group Art Unit	
				Examiner Name	
1	of	1	Attorney Docket Number	D-4557 US	

U.S. PATENT DOCUMENTS						
Examiner Initials	Cite No.	U.S. Patent Document		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number Code	Kind			
		5,933,768		Skold, et al	08-03-1999	RECEIVED APR 07 2003
		5,710,797		Segal,et al	01-20-1998	
		5,719,899		Thielecke, et al.	02-17-1998	
		6,404,760		Holtzman, et al	06-11-2002	
						Technology Center 260

[illegible]

OTHER PRIOR ART - NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	(Including Name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc...), date, page(s), volume-issue number(s), publisher, city, and/or country where published.	T
		PCT International Search Report dated February 28, 2003 of International Application No. PCT/US02/27451 filed August 29, 2002	

Examiner Signature		Date Considered	
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* EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP § 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to the applicant.



3 2661
SI
1P-03-03

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: LEARNED, Rachel

Examiner:

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OCT 27 2003

Serial Number: 09/943,770

Group Art Unit: 2661

Technology Center 2600

Filed: 08/31/2001

Atty. Dkt. No: D-4557

For: SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING
DIGITALLY MODULATED SIGNALS

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to the Commissioner of Patents and Trademarks, U. S. Patent and Trademark Office, P. O. Box 1450, Alexandria, VA 22313-1450 on Oct. 20 2003

By: [Signature]
Robert K. Tendler
Reg. No.: 24,581
Attorney for Applicant

Dear Assistant Commissioner:

INFORMATION DISCLOSURE STATEMENT

Applicants submit this statement in accordance to the duty of disclosure under 37 C.F.R. §§1.56, 1.97, and 1.98, and requests consideration of this Information Disclosure Statement.

Compliance with 37 C.F.R. §1.97: This Information Disclosure Statement is filed within three (3) months of the filing date of a National Application or before the mailing date of a first office action on the merits. No fee or certification is required.

Information Cited: The Applicants hereby make of record in the above-identified application, the information listed on the attached form PTO/SB/08A. The order of presentation of the references should not be construed as an indication of the importance of the reference. As all the references listed on attached Form PTO/SB/08A are in English, no commentary is required.

Remarks: A copy of each reference which is not a U. S. patent, together with a listing on Form PTO/SB/08A, is submitted herewith. Applicants respectfully request that:

1. The Examiner consider completely the cited information, along with any other information, in reaching a determination concerning the patentability of the present claims;

2. The enclosed form PTO/SB/08A be signed by the Examiner to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

3. The citations for the information be printed on any patent which issues from this application.

By submitting this Information Disclosure Statement, the Applicants make no representation that a search has been performed, of the extent of any search performed, or that more relevant information does not exist.

By submitting this Information Disclosure Statement, the Applicants make no representation that the information cited in the Statement is, or is considered to be, material to patentability as defined in 37 C.F.R. §1.56(b).

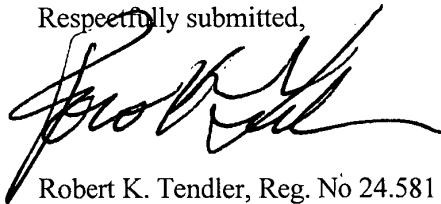
By submitting this Information Disclosure Statement, the Applicants make no representation that the information cited in the Statement is, or is considered to be, in fact, prior art as defined in 37 C.F.R. §102.

Notwithstanding any statement by the Applicant, the Examiner is urged to form his own conclusion regarding the relevance of the cited information.

An early and favorable action is hereby requested.

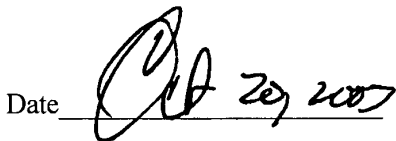
Please enter in the above application and communicate in all related matters with the undersigned. All necessary fees are intended to be included, however the Office is hereby authorized to charge any deficiency or credit any overpayment in the fees to deposit account #190130.

Respectfully submitted,

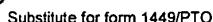


Robert K. Tendler, Reg. No 24.581

Date



Robert K. Tendler, Esq.
65 Atlantic Avenue
Boston, MA 02110
Tel. No. (617) 723 7268
Fax. No. (617) 723 7186



Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

(Use as many sheets as necessary)

Sheet	1
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of 2

Complete if Known

Application Number	09/943.770
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Filing Date	08/31/2001
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First Named Inventor	Rachel Learned
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Art Unit

Examiner Name _____

Attorney Docket Number	D-4557
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U. S. PATENT DOCUMENTS

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OCT 27 2003
Technology Center 2600

FOREIGN PATENT DOCUMENTS

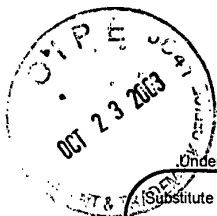
[illegible]

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.



INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)		Complete if Known	
		Application Number	09/943,770
		Filing Date	08/31/2001
		First Named Inventor	Rachel Learned
		Art Unit	2661
Examiner Name			
Sheet 2	of 2	Attorney Docket Number	D-4557

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OCT 27 2003
Technology Center 2600

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		XIAODONG WANG and H. VINCENT POOR, "Iterative (Turbo) Soft Interference Cancellation and Decoding for Coded CDMA," IEEE Transactions on Communications, Vol. 47, No. 7 July 1999	
		S. VERDU, Multi-User Detection, Cambridge University Press, 1998	

Examiner Signature	Date Considered
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.
1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.
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Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	123	(receiver and "pilot signal").ab. and "375"/\$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/18 12:06
S3	9	((("5,933,768") or ("5,710,797") or ("5,719,899") or ("6,404,760") or ("6,219,314") or ("6,198,775") or ("5,982,813") or ("5,790,606") or ("6,122,269"))).PN.	USPAT	OR	OFF	2004/11/15 11:24
S4	97	learned.in.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:00
S5	65	parameter and "training signal" and estimat\$3 and (signal adj separat\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/16 14:20
S6	56201	"375"/\$.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:03
S7	23	S5 and S6	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:03
S8	15	(parameter adj estimat\$3) and "training signal" and estimat\$3 and (signal adj separat\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:51
S9	15	(parameter adj estimat\$3) and "training signal" and (signal adj separat\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:52

S10	4	(parameter adj estimat\$3) same "training signal" and (signal adj separat\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 14:52
S11	378	375/149.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 16:23
S12	378	375/149.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 16:45
S13	1437	375/346.ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 16:46
S14	61	375/346.ccls. and estimat\$3 and parameter and modulat\$3 and power and frequency and (time or timing or clock) and training	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/15 17:03
S15	6	(parameter adj estimat\$3) and "training signal" and interference and "transfer function"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2004/11/16 14:22

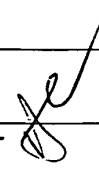


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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,770	08/31/2001	Rachel E. Learned	D-4557	2465
7590		01/06/2005	EXAMINER	
Robert K. Tendler		FILE, ERIN M		
65 Atlantic Avenue		ART UNIT		
Boston, MA 02110		PAPER NUMBER		
		2634		
DATE MAILED: 01/06/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/943,770	LEARNED, RACHEL E.	
	Examiner	Art Unit	
	Erin M. File	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on ____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-10 is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5) ☐ Claim(s) ____ is/are allowed.

6) ☒ Claim(s) 1-3, 5-7, 9 and 10 is/are rejected.

7) ☒ Claim(s) 4 and 8 is/are objected to.

8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 10/23/2003.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: ____.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this

Office action:

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, 3, 9 and 10 are rejected under 35 U.S.C. 102(b) as being unpatentable over Segal.

Claim 1, Segal discloses a method for providing parameter estimation for multi-user detection systems in which the received signals are provided with training sequences, comprising the steps:

- A signal is isolated (fig 10a, 1009) and its parameters estimated (1010) (col 6 lines 9,10).
- Signal parameter estimations are performed in 1006, 1010, or 1012 which can include incorporation of training signals (fig 10a, col 6, lines 53-54) used to recreate the input signal. This recreated signal is subtracted from the input signal at the signal subtractor sub-unit 1007 (fig 10a, col 6, lines 2-4).

- The subtracted signal is fed to a cluster processor (1304) to re-detect the information bits of the desired signal, and re-estimate its parameters. (col 7, lines 31-36)

Claim 2, Segal discloses a signal separator (fig 13, 1301) that receives parameter estimates from a plurality of cluster processors and inputs separated signals to these processors. Cluster Processors (1304) detect data bits and track parameters of a cluster of signals. (col 8, lines 1- 4). These parameters determined, as shown in Figure 12, are sufficient to define the transfer functions of the signals.

Claim 3, inherits the limitations of claim 2. Segal discloses a possible sequence of operations that may be used to extract the signal parameters (fig 12). The signal from the receiver generates a timing reference (1201), one correlating the received signal against a training sequence that is stored in the receiver (col 6, 32-37). After the timing estimation is completed other parameters, such as frequency (1202) and amplitude (1203) are estimated and are sent to a signal separation unit (1301). Each signal is processed and tracked (fig 16, 1603) with respect to time and frequency.

Claim 9, inherits the limitations of claim 2. Segal discloses after an initial estimation a multi-user detection system is used that simultaneously tracks all signals in the channel (fig 13).

Claim 10, inherits the limitations of claim 9, further Segal discloses simultaneous tracking includes parallel processors (fig 13, 1304) which training symbols in the separated signals are used to find signal parameters.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 5, 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Segal in view of Hoffman et al.

Claim 5, inherits the limitations of Claim 2. Segal further discloses first estimated channel parameters (fig 12, col 5, line 61 – col 6, line 21). Segal does not disclose means to provide an acquisition channel, however Hoffmann teaches a wireless communication system with an access channel. In this structure Hoffman teaches an access channel for efficient acquisition of an access signal at a base station in a receiver used for parameter estimation (abstract). The use of an acquisition or pilot channel in receivers is common as it allows faster and more accurate synchronization of the receiver. Because of the value of using an

Art Unit: 2634

acquisition channel in a receiver it would be obvious to one skilled in the art at the time of invention to incorporate Hoffman's acquisition channel method into Segal's apparatus.

Claim 6, inherits the limitations of Claim 2. Segal discloses a tracking unit where a new signal is detected and its parameter's estimated and tracked (col 5, line 61 – col 6, line 21). Segal does not disclose an acquisition channel. However, Hoffmann teaches a wireless communication system with an access channel. In this structure Hoffman teaches an access channel for efficient acquisition of an access signal at a base station in a receiver which is used for parameter estimation (abstract). The use of an acquisition or pilot channel in receivers is common as it allows faster and more accurate synchronization of the receiver. Because of the value of using an acquisition channel in a receiver it would be obvious to one skilled in the art at the time of invention to incorporate Hoffman's acquisition channel method into Segal's apparatus.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claim 7 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7, is rejected as disclosing a negative limitation of Claim 6.

Claim Objections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1, 2, 4 are objected to as they lack sufficient antecedent basis.

Claim 1, recites the limitation "the received signals". There is insufficient antecedent basis for this limitation in the claim.

Appropriate correction is required.

Claim 2, recites the limitation, "for determining *the* channel transfer functions to *said* channel transfer function ". There is insufficient antecedent basis for this limitation in the claim.

Appropriate correction is required.

Claim 4, recites the limitation "the estimated channel function for each interfering signal". There is insufficient antecedent basis for this limitation in the claim.

Appropriate correction is required.

Claim Objections

Claims 4, 8 are objected to as dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erin M. File whose telephone number is (571)272-6040. The examiner can normally be reached on M-F 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on (571)272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



STEPHEN CHIN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

Notice of References Cited	Application/Control No. 09/943,770	Applicant(s)/Patent Under Reexamination LEARNED, RACHEL E.	
	Examiner Erin M. File	Art Unit 2634	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,483,866	11-2002	Suzuki, Hiroshi	375/149
	B	US-5,710,797	01-1998	Segal et al.	375/346
	C	US-6,026,130	02-2000	Rahmatullah et al.	375/340
	D	US-2001/0026599 a1	10-2001	Hoffmann et al.	375/343
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	F	US-			
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	H	US-			
	I	US-			
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	K	US-			
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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	P					
	Q					
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	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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INFORMATION DISCLOSURE
STATEMENT BY APPLICANT

Application Number		09/943,770	
Filing Date		8/31/01	
First Named Inventor		LEARNED, Rachel	
Group Art Unit			
Examiner Name			
Attorney Docket Number		D-4557 US	

1 of 1

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	U.S. Patent Document Number Code	Kind	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
EE		5,933,768		Skold, et al	08-03-1999	RECEIVED APR 0 7 2003 Technology Center 2600
EE		5,710,797		Segal, et al	01-20-1998	
EE		5,719,899		Thielecke, et al.	02-17-1998	
EE		6,404,760		Holtzman, et al	06-11-2002	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document Office Code	Number	Kind	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T

OTHER PRIOR ART - NON PATENT LITERATURE DOCUMENTS

Examiner Initials	Cite No.	(Including Name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc...), date, page(s), volume-issue number(s), publisher, city, and/or country where published.	T
EE		PCT International Search Report dated February 28, 2003 of International Application No. PCT/US02/27451 filed August 29, 2002	

Examiner Signature		Date Considered	11.14.04
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* EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP § 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to the applicant.



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Sheet	1	of	2
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Application Number	09/943,770
Filing Date	08/31/2001
First Named Inventor	Rachel Learned
Art Unit	
Examiner Name	
Attorney Docket Number	D-4557

U. S. PATENT DOCUMENTS					
Examiner Initials*	Cite No.¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code² (if known)			
EE		US 6,219,314	04/17/2001	Varanasi	
EF		US 6,198,775	03/06/2001	Khayrallah	
FF		US 5,982,813	11/09/1999	Dutta	
FE		US 5,790,606	08/04/1998	Dent	
FF		US 6,122,269	09/19/2000	Wales	
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Examiner Signature	<i>1-20</i>	Date Considered	11.16.84
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This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.



PTO/SB/08B (08-03)
Approved for use through 07/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Complete if Known		
	Application Number	09/943,770	
	Filing Date	08/31/2001	
	First Named Inventor	Rachel Learned	
	Art Unit	2661	
	Examiner Name		
Sheet 2 of 2	Attorney Docket Number	D-4557	

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NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
ER		XIAODONG WANG and H. VINCENT POOR, "Iterative (Turbo) Soft Interference Cancellation and Decoding for Coded CDMA," IEEE Transactions on Communications, Vol. 47, No. 7 July 1999	
ER		S. VERDU, Multi-User Detection, Cambridge University Press, 1998	

Examiner Signature		Date Considered	11.16.04
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.
1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.
This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

Erin M. File

2634

A	Appeal
O	Objected

[illegible]



UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov



Bib Data Sheet

CONFIRMATION NO. 2465

SERIAL NUMBER 09/943,770	FILING DATE 08/31/2001 RULE	CLASS 370	GROUP ART UNIT 2661	ATTORNEY DOCKET NO. D-4557						
APPLICANTS Rachel E. Learned, Waltham, MA; ** CONTINUING DATA ***** THIS APPLN CLAIMS BENEFIT OF 60/233,870 09/20/2000 ** FOREIGN APPLICATIONS *****										
IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 10/04/2001										
Foreign Priority claimed ☐ yes ☒ no 35 USC 119 (a-d) conditions ☐ yes ☒ no ☐ Met after met Allowance Verified and Acknowledged <i>[Signature]</i> Examiner's Signature <i>ET</i> Initials		STATE OR COUNTRY MA	SHEETS DRAWING 4	TOTAL CLAIMS 10	INDEPENDENT CLAIMS 2					
ADDRESS Robert K. Tendler 65 Atlantic Avenue Boston ,MA 02110										
TITLE System for parameter estimation and tracking of interfering digitally modulated signals										
FILING FEE RECEIVED 710	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following: <table border="1" style="float: right;"> <tr><td>☐ All Fees</td></tr> <tr><td>☐ 1.16 Fees (Filing)</td></tr> <tr><td>☐ 1.17 Fees (Processing Ext. of time)</td></tr> <tr><td>☐ 1.18 Fees (Issue)</td></tr> <tr><td>☐ Other _____</td></tr> <tr><td>☐ Credit</td></tr> </table>				☐ All Fees	☐ 1.16 Fees (Filing)	☐ 1.17 Fees (Processing Ext. of time)	☐ 1.18 Fees (Issue)	☐ Other _____	☐ Credit
☐ All Fees										
☐ 1.16 Fees (Filing)										
☐ 1.17 Fees (Processing Ext. of time)										
☐ 1.18 Fees (Issue)										
☐ Other _____										
☐ Credit										

Search Notes

Application/Control No.

09/943,770

Examiner

Erin M. File

Applicant(s)/Patent under
Reexamination

LEARNED, RACHEL E.

Art Unit

2634

SEARCHED

Class	Subclass	Date	Examiner
375	149	11/15/2004	EMF
375	340	11/16/2004	EMF
375	346	11/15/2004	emf

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner

**SEARCH NOTES
(INCLUDING SEARCH STRATEGY)**

	DATE	EXMR
EAST US PAT, USPGPUB, EPO, JPO DERWENT, IBM	11/15/2004	EMF
PALM INVENTORSHIP	11/15/2004	EMF



263'

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Rachel E. Learned Examiner: Erin M. File
Application No: 09/943,770 Art Unit: 2634
Filing Date: 08/31/2001 Confirmation No.: 2465
Title: System for Parameter Estimation and Tracking of Interfering Digitally
Modulated Signals
Atty. Docket: D-4557

Commissioner of Patents and Trademarks
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Transmitted herewith is an Amendment in the above-identified application.

The fee has been calculated as shown below:

CLAIMS AS AMENDED

	Claims Remaining After Amendment		Highest Previously Paid For		Present Extra		Rate		Additional Fee
TOTAL CLAIMS	11	-	20	=	0	X	\$50	=	\$ 0.00
INDEP. CLAIMS	3	-	3	=	0	X	\$200	=	\$ 0.00

TOTAL ADDITIONAL FEE FOR THIS AMENDMENT

\$ 0.00

Please charge any additional fees or credit overpayment to Deposit Account 19-0130. A duplicate of this sheet is enclosed.

Respectfully submitted,

Robert K. Tandler
Reg. No: 24,581
65 Atlantic Avenue
Boston, MA 02110
Telephone No: (617) 723-7268

Date:



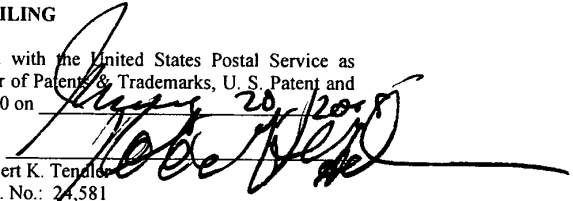
2634

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Rachel E. Learned Examiner: Erin M. File
Application No: 09/943,770 Art Unit: 2634
Filing Date: 08/31/2001 Confirmation No.: 2465
Title: System for Parameter Estimation and Tracking of Interfering Digitally
Modulated Signals
Atty. Docket: D-4557

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to the Commissioner of Patents & Trademarks, U. S. Patent and Trademark Office, P. O. Box 1450, Alexandria, VA 22313-1450 on January 20, 2005

By: 
Robert K. Tendler
Reg. No.: 24,581
Attorney for Applicant

AMENDMENT

Commissioner of Patents & Trademarks
U.S. Patent and Trademark Office
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

Responsive to the Office Action of January 6, 2005, please amend the above-identified application as follows:

In the claims, please amend the claims as follows and add Claim 11:

AMENDMENTS TO THE CLAIMS

1. (Cancel)
2. (Currently amended) In a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit for use in conjunction with a signal separation unit, in which each received signal has associated channel transfer functions, comprising:
 - a signal processor for determining ~~the~~ said channel transfer functions for each received signal; and,
 - means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals.
3. (Original) The parameter estimation unit of Claim 2, wherein said multi-user detection system includes a base station with a base station clock having a clock frequency offset, and wherein said channel transfer function parameters include for each received signal at least one of received power, oscillator phase of the oscillator used to produce an interfering signal, timing offset relative to the base station clock frequency offset, number of multi-path replicas and delays for each replica.
4. (Cancel)

5. (Original) The parameter estimation unit of Claim 2, wherein the multi-user detection system includes providing an acquisition channel, and wherein the first derived estimated channel transfer function is derived from acquisition channel parameters.

6. (Currently amended) The parameter estimation unit of Claim 2, wherein said multi-user detection system includes a tracking unit for acquired signals, and wherein in the presence of a new signal in the acquisition channel of said parameter estimation unit estimates the channel transfer function prior to signal switching from the acquisition channel to the traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter.

7. (Currently amended) The parameter estimation unit of Claim ~~6~~, 2, and further including a traffic channel, and wherein for said traffic channel phase is tracked without utilization of the estimates from the acquisition channel.

8. (Currently amended) The parameter estimation unit of Claim ~~7~~ 6, wherein all received signals have training portions, and wherein for a second interfering signal ~~detected by said base station~~ and assigned to said traffic channel, said parameter estimation unit recreates the training signal portion of every received signal prior to the last received signal and subtracts the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

9. (Original) The parameter estimation unit of Claim 2, wherein after initial estimate generation, said multi-user detection system simultaneously tracks all signals in said traffic channel.

10. (Original) The parameter estimation unit of Claim 9, wherein said simultaneous tracking includes blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel.

11. (New) In a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit for use in conjunction with a signal separation unit for estimating channel transfer function parameters from channel transfer functions, comprising:

a signal processor for determining said channel transfer functions for each received signal; and,

means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis, said multi-user detection system including a tracking unit for acquired signals, and in the presence of a new signal in the acquisition channel of said parameter estimation unit estimating the channel transfer function prior to signal switching from the acquisition channel to a traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter, all received signals having training portions, a second interfering signal being and assigned to said traffic channel, said parameter estimation unit recreating the training signal portion of every received signal prior to the last received signal and subtracting the recreated

training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

REMARKS

The Examiner's action of January 6, 2005 is noted in which Claims 4 and 8 are said to contain allowable subject matter. Moreover, Claims 1, 2 and 4 are objected to under 35 USC 112.

Claims 1 and 4 have been canceled without prejudice and those portions of Claims 4 and 8 used in independent claims have been re-worded to correct the antecedent basis rejection.

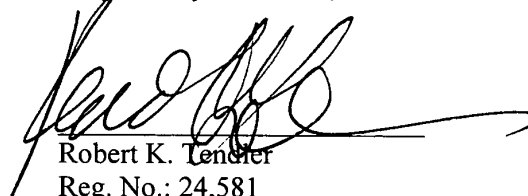
Claim 2 has been amended to recite the subject matter of Claim 4. Therefore, Claim 2 and the claims that depend therefrom are in condition for allowance.

Applicant provides a new Claim 11, which constitutes the original Claim 2 and inserts the allowable subject matter of Claim 8.

This places Claim 11 in condition for allowance.

Allowance of the claims and issuance of the case are therefore earnestly solicited.

Respectfully submitted,



Robert K. Tender

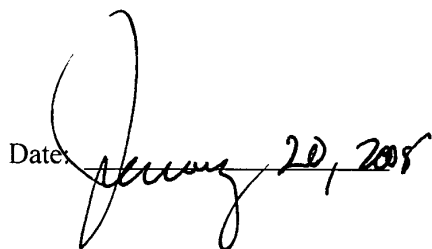
Reg. No.: 24,581

65 Atlantic Avenue

Boston, MA 02110

Tel: (617) 723-7268

Date:



PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 2000

Application or Docket Number

D-4557
09/943 770

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	10	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	10 minus 20 =	0
INDEPENDENT CLAIMS	2 minus 3 =	0
MULTIPLE DEPENDENT CLAIM PRESENT ☐		

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	9	Minus	20 =
Independent	2	Minus	3 =
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐			

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total		Minus	20 =
Independent		Minus	3 =
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐			

	(Column 1)	(Column 2)	(Column 3)
AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total		Minus	20 =
Independent		Minus	3 =
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐			

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

SMALL ENTITY TYPE ☐ OR OTHER THAN SMALL ENTITY

RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL		OR	TOTAL	710

SMALL ENTITY OR OTHER THAN SMALL ENTITY

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	



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NOTICE OF ALLOWANCE AND FEE(S) DUE

7590

04/08/2005

Robert K. Tendler
65 Atlantic Avenue
Boston, MA 02110

EXAMINER

FILE, ERIN M

ART UNIT

PAPER NUMBER

2634

DATE MAILED: 04/08/2005

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,770	08/31/2001	Rachel E. Learned	D-4557	2465

TITLE OF INVENTION: SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$1700	07/08/2005

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHT. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THE STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee Transmittal and pay the PUBLICATION FEE (if required) and 1 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issued on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is the patentee's responsibility to ensure timely payment of maintenance fees when due.

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7590

04/08/2005

Robert K. Tendler
65 Atlantic Avenue
Boston, MA 02110

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I hereby certify that this Fee(s) Transmittal is being deposited with the Un States Postal Service with sufficient postage for first class mail in an envel addressed to the Mail Stop ISSUE FEE address above, or being facsim transmitted to the USPTO (703) 746-4000, on the date indicated below.

(Depositor's na
(Signat
(D

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,770	08/31/2001	Rachel E. Learned	D-4557	2465

TITLE OF INVENTION: SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$1700	07/08/2005

EXAMINER	ART UNIT	CLASS-SUBCLASS
FILE, ERIN M	2634	375-346000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Governm

4a. The following fee(s) are enclosed:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

- ☐ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above. NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other part interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,770	08/31/2001	Rachel E. Learned	D-4557	2465
7590 04/08/2005				
Robert K. Tendler 65 Atlantic Avenue Boston, MA 02110				
EXAMINER FILE, ERIN M				
ART UNIT PAPER NUMBER				
2634				

DATE MAILED: 04/08/2005

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 798 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 798 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office Patent Legal Administration at (571) 272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

3

Notice of Allowability	Application No.	Applicant(s)	
	09/943,770	LEARNED, RACHEL E.	
	Examiner	Art Unit	
	Erin M. File	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--
 All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 1/24/2005.
2. ☒ The allowed claim(s) is/are 1-9.
3. ☒ The drawings filed on 31 August 2001 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
 - * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|---|
| 1. ☐ Notice of References Cited (PTO-892) | 5. ☐ Notice of Informal Patent Application (PTO-152) |
| 2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date _____. |
| 3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. ☒ Examiner's Amendment/Comment |
| 4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. ☐ Examiner's Statement of Reasons for Allowance |
| | 9. ☐ Other _____. |

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Robert K. Tendler, Reg. No. 24,581 on 3/30/2005.

1. The application has been amended as follows:

Claim 6. The parameter estimation unit of Claim 2, wherein said multi-user detection system includes a tracking unit for acquired signals, and wherein in the presence of a new signal in the acquisition channel of said parameter estimation unit estimates the channel transfer function prior to signal switching from an the acquisition channel to the traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter.

Claim 8. The parameter estimation unit of Claim 6, wherein all received signals have training portions, and wherein for a second interfering signal ~~and~~ assigned to said traffic channel, said parameter estimation unit recreates the training signal portion of every received signal prior to the last received signal and subtracts the recreated training signals from the training portion of the last received signal to

provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

Claim 9. The parameter estimation unit of Claim 2, wherein after initial estimate generation, said multi-user detection system simultaneously tracks all signals in a ~~said~~ traffic channel.

Claim 11. In a multi-user detection system in which interfering signals are purposely allowed to exist, a parameter estimation unit for use in conjunction with a signal separation unit for estimating channel transfer function parameters from channel transfer functions, comprising: a signal processor for determining said channel transfer functions for each received signal; and, means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis, said multi-user detection system including a tracking unit for acquired signals, and in the presence of a new signal in an ~~the~~ acquisition channel of said parameter estimation unit estimating the channel transfer function prior to signal switching from the acquisition channel to a traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter, all received signals having training portions, a second interfering signal being and assigned to said traffic channel, said parameter estimation unit recreating the training signal portion of every received signal prior to the last received signal and subtracting

Art Unit: 2634

the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

2. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erin M. File whose telephone number is (571)272-6040. The examiner can normally be reached on M-F 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on (571)272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Erin File

3.30.2005


STEPHEN CHIN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

Examiner-Initiated Interview Summary	Application No.		Applicant(s)	
	09/943,770		LEARNED, RACHEL E.	
	Examiner		Art Unit	
	Erin M. File		2634	

All Participants:

(1) Erin M. File.

(2) Robert K. Tendler
Reg. No: 24,581.

Status of Application: pending

(3) _____

(4) _____

Date of Interview: 30 March 2005

Time: 5:15PM

Type of Interview:

☒ Telephonic

☐ Video Conference

☐ Personal (Copy given to: ☐ Applicant ☐ Applicant's representative)

Exhibit Shown or Demonstrated: ☐ Yes ☐ No

If Yes, provide a brief description:

Part I.

Rejection(s) discussed:

Claims discussed:

6, 8, 9, and 11

Prior art documents discussed:

Part II.

SUBSTANCE OF INTERVIEW DESCRIBING THE GENERAL NATURE OF WHAT WAS DISCUSSED:

Attorney agreed to small changes in minor informalities in claims 6, 8, 9, and 11.

Part III.

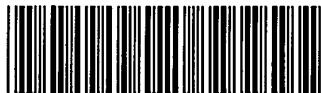
☒ It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview directly resulted in the allowance of the application. The examiner will provide a written summary of the substance of the interview in the Notice of Allowability.

☐ It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview did not result in resolution of all issues. A brief summary by the examiner appears in Part II above.

Erin File
[Signature]

(Examiner/SPE Signature)

(Applicant/Applicant's Representative Signature – if appropriate)

Search Notes

Application/Control No.

09/943,770

Examiner

Erin M. File

Applicant(s)/Patent under
Reexamination

LEARNED, RACHEL E.

Art Unit

2634

SEARCHED

Class	Subclass	Date	Examiner
375	149	11/15/2004	EMF
375	340	11/15/2004	EMF
375	346	11/15/2004	EMF

INTERFERENCE SEARCHED

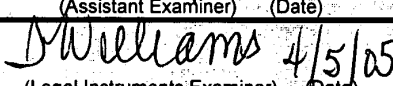
Class	Subclass	Date	Examiner
375	316	3/28/2005	EMF
375	346	11/15/2005	EMF

**SEARCH NOTES
(INCLUDING SEARCH STRATEGY)**

	DATE	EXMR
EAST US PAT, USPGPUB, EPO, JPO DERWENT, IBM	3/28/2005	EMF
PALM INVENTORSHIP	11/15/2004	EMF

Issue Classification 	Application/Control No.		Applicant(s)/Patent under Reexamination	
	09/943,770		LEARNED, RACHEL E.	
	Examiner		Art Unit	
	Erin M. File		2634	

ISSUE CLASSIFICATION									
ORIGINAL					CROSS REFERENCE(S)				
CLASS		SUBCLASS			CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)			
375		346			375	149	316	340	
INTERNATIONAL CLASSIFICATION									
H	0	3	4	1/04					
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				/					
				/					
				/					

Erin M. File (Assistant Examiner)	3/28/2005 (Date)	 STEPHEN CHUN SUPERVISORY PATENT EXAMINER TECHNOLOGY CENTER 2000 (Primary Examiner)	Total Claims Allowed: 9
 (Legal Instruments Examiner)	4/5/05 (Date)		O.G. Print Claim(s) 2

☒ Claims renumbered in the same order as presented by applicant		☐ CPA		☐ T.D.		☐ R.1.47	
Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91
	2		32		62		92
	3		33		63		93
	4		34		64		94
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	7		37		67		97
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	9		39		69		99
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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (703) 746-4000

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

7590

04/08/2005

Robert K. Tendler

65 Atlantic Avenue

Boston, MA 02110

06/06/2005 MBERHE1 00000075 190130 09943770

01 FC:1501 1400.00 DA

02 FC:1504 300.00 DA

03 FC:8001 30.00 DA

Note: A certificate of mailing can only be used for domestic mailings of Fee(s) Transmittal. This certificate cannot be used for any other accompany papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (703) 746-4000, on the date indicated below.

Robert K. Tendler

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,770	08/31/2001	Rachel E. Learned	D-4557	2465

TITLE OF INVENTION: SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$1700	07/08/2005

EXAMINER	ART UNIT	CLASS-SUBCLASS
FILE, ERIN M	2634	375-346000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Daniel J. Long

2 Robert K. Tendler

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

BAE Systems Information and Electronic
Systems Integration Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Nashua, New Hampshire, USA

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:

☒ Issue Fee☒ Publication Fee (No small entity discount permitted)☒ Advance Order - # of Copies 10

4b. Payment of Fee(s):

☐ A check in the amount of the fee(s) is enclosed.☐ Payment by credit card. Form PTO-2038 is attached.☒ The Director is hereby authorized by charge the required fee(s), or credit any overpayment Deposit Account Number 19-0130 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above. NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other part interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature

Robert K. Tendler

Date

June 1, 2005

Typed or printed name

Registration No.

24,581

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 14 Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

● PRINTER RUSH ●

(PTO ASSISTANCE)

Application : <u>09/943770</u>	Examiner : <u>Chin</u>	GAU : <u>2634</u>
From: <u>NIB</u>	Location: <u>(IDC)</u> FMF FDC	Date: <u>7-27-05</u>
Tracking #: <u>06105007-6</u>		Week Date: <u>5-16-05</u>

DOC CODE	DOC DATE	MISCELLANEOUS
☐ 1449		☐ Continuing Data
☐ IDS		☐ Foreign Priority
☐ CLM		☐ Document Legibility
☐ IIFW		☐ Fees
☐ SRFW		☐ Other
☒ DRW	<u>8-31-01</u>	
☐ OATH		
☐ 312		
☐ SPEC		

[RUSH] MESSAGE: Attn. Chief Draftsperson.

Shaded lines running through middle of

Figures 1, 2, 3, & 4.

Thank You

NIB

[XRUSH] RESPONSE: _____

Drawing corrected

INITIALS: WJ

NOTE: This form will be included as part of the official USPTO record, with the Response document coded as XRUSH.
REV 10/04

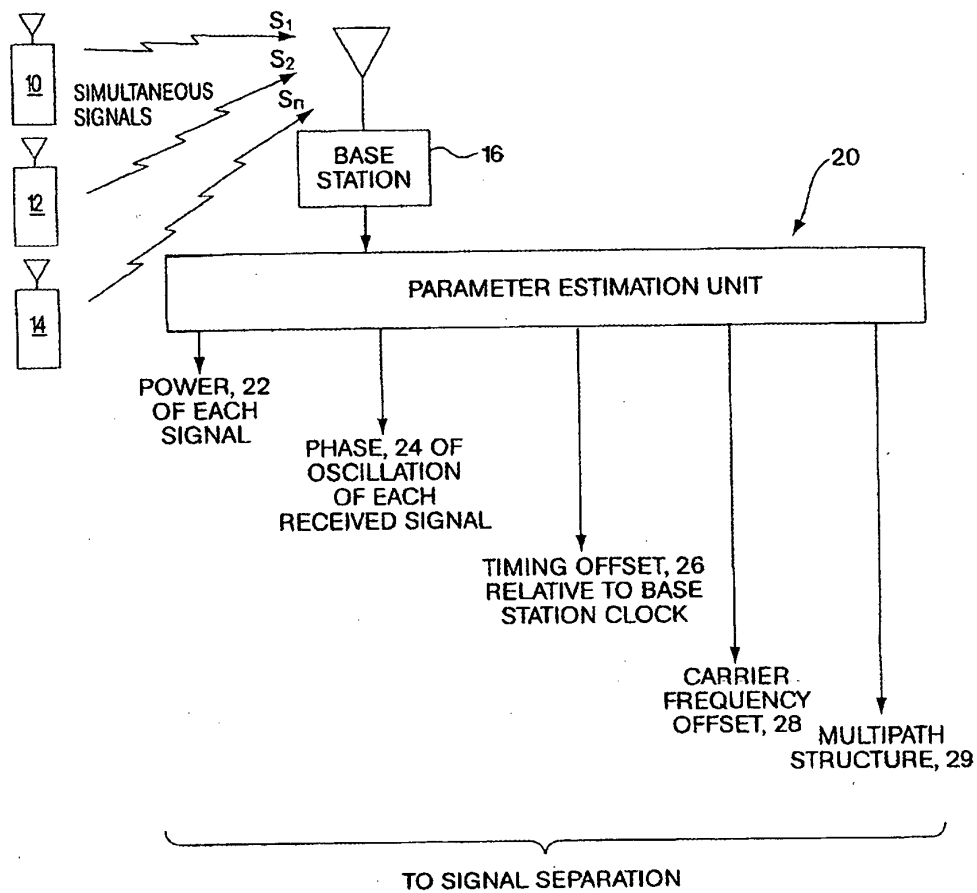


Fig. 1

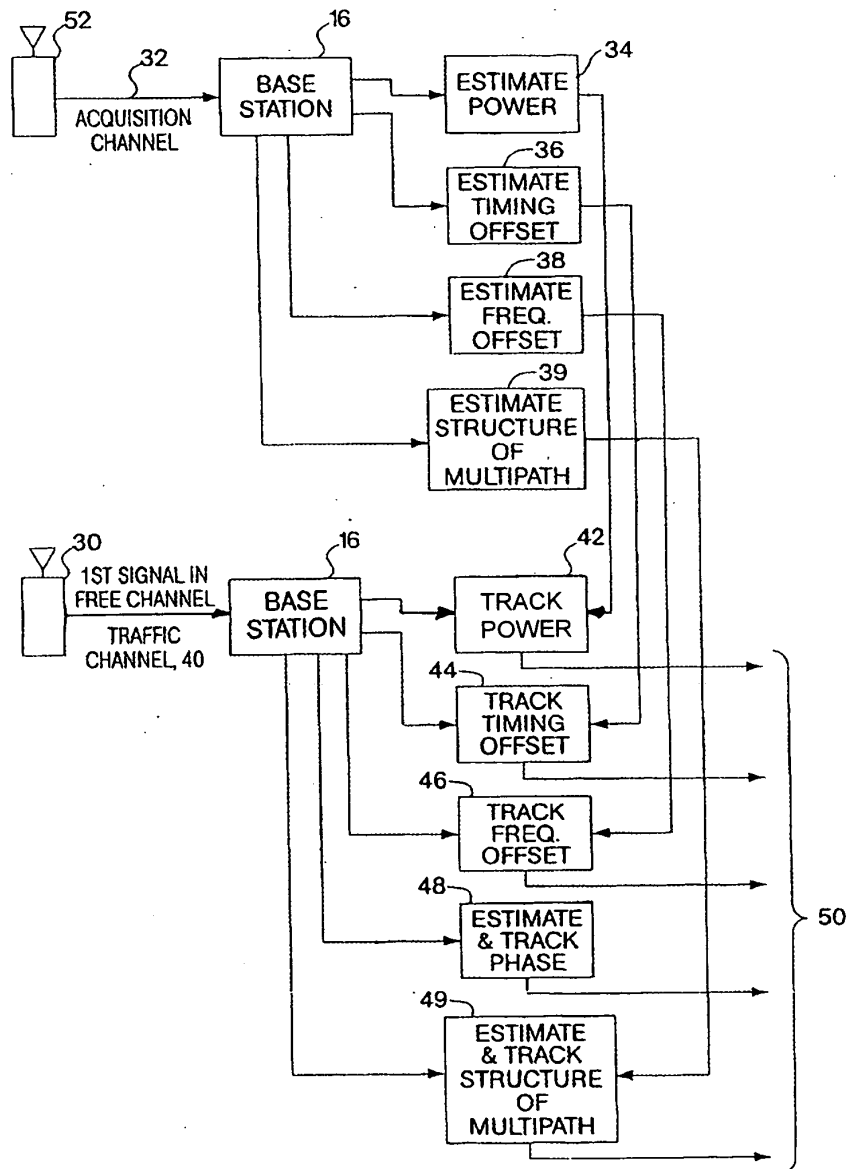


Fig. 2

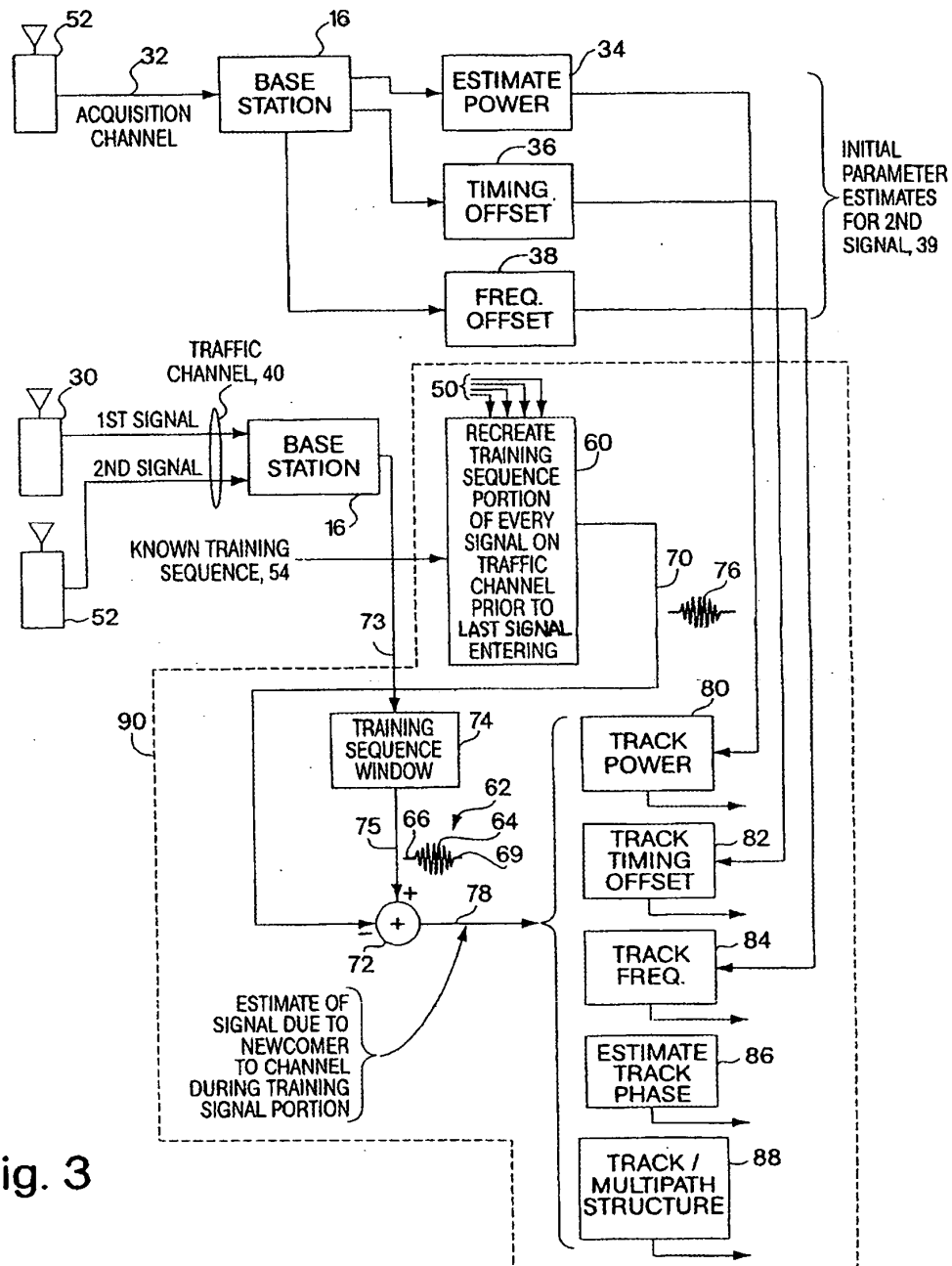


Fig. 3

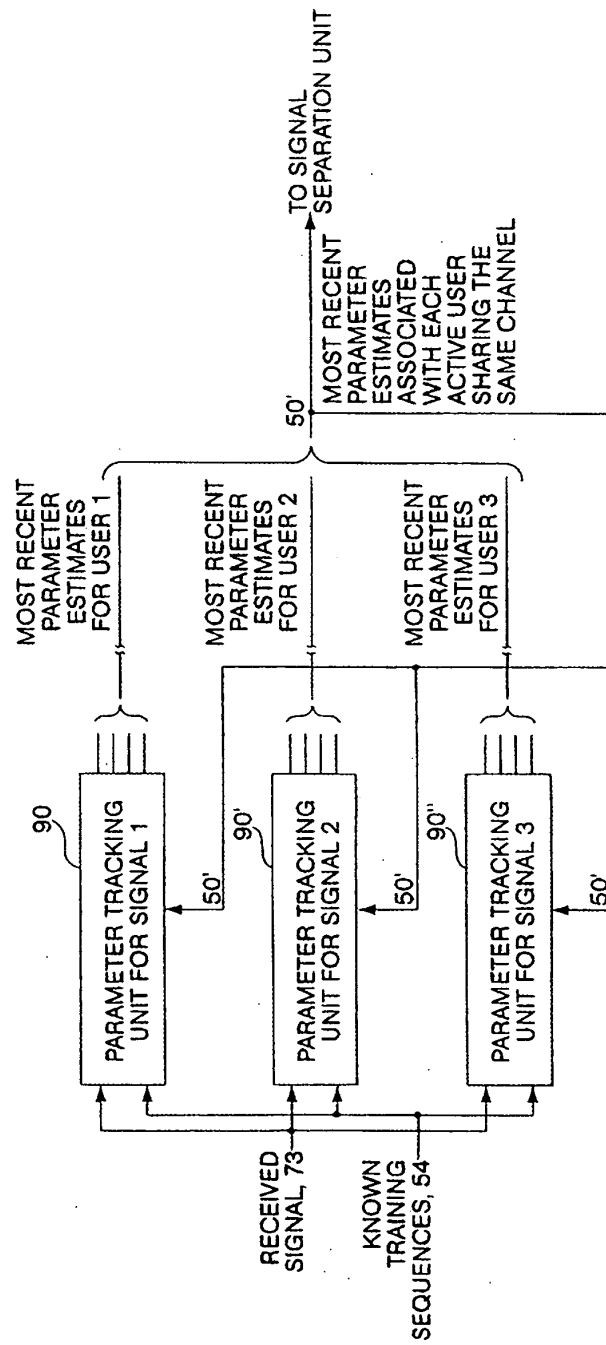


Fig. 4

POWER OF ATTORNEY FOR PATENT APPLICATIONS

Under CFR § 3.73(b), Collision Technology, LLC, a corporation, hereby certifies that it is the Assignee of the entire right, title, and interest in and to the patent applications listed below. Each of the patent applications listed below is assigned to Collision Technology, LLC. As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the Assignee was submitted for recordation pursuant to 37 CFR 3.11 as shown in the Reel/Frame numbers listed below.

Filing Date	Application Serial No.; Patent No. (if issued)	Title	Reel/Frame
10/03/2003	10/678,203; 6,831,574	MULTI-TURBO MULTI- USER DETECTOR	014073/0269 026190/0812
04/05/2004	10/818,536; 6,967,598	REDUCED COMPLEXITY MULTI-TURBO MULTI- USER DETECTOR	014525/0140 026190/0812
03/24/2005	10/529,019; 7,599,346	BANDWIDTH- EFFICIENT WIRELESS NETWORK MODEM	016520/0107 026190/0812 026193/0661
08/27/2009	12/548,502	BANDWIDTH EFFICIENT WIRELESS NETWORK MODEM	026190/0812
02/03/2004	10/486,004; 7,486,722	BANDWIDTH EFFICIENT CABLE NETWORK MODEM	013771/0874 014405/0749 026190/0812 026193/0661
02/11/2004	10/486,871; 7,245,673	WINDOWED MULTIUSER DETECTION	013816/0233 015656/0249 026190/0812 026193/0661
12/21/2004	10/497,556; 7,126,533	DIRECTION-FINDING FOR MULTIPLE COCHANNEL SOURCES	014737/0931 013824/0323 026190/0812 026193/0661
04/19/2005	10/531,772; 7,463,703	JOINT SYMBOL, AMPLITUDE, AND RATE ESTIMATOR	015999/0543 026190/0812 026193/0661
10/15/2008	12/251,571; 7,590,203	JOINT SYMBOL, AMPLITUDE, AND RATE ESTIMATOR	021690/0566 026190/0812
10/15/2008	12/251,575; 7,583,757	JOINT SYMBOL, AMPLITUDE, AND RATE ESTIMATOR	021690/0608 026190/0812
06/25/2009	12/491,332; 7,920,651	JOINT SYMBOL, AMPLITUDE, AND RATE	022879/0419 026190/0812

		ESTIMATOR	
12/23/2003	10/482,599; 7,428,261	CROSS-SYSTEM INTERFERENCE CANCELLATION FOR MULTICARRIER CDMA AND OFDM	013823/0522 014271/0189 026190/0812 026193/0661
12/01/2005	11/291,883; 7,593,473	TREE STRUCTURED MULTICARRIER MULTIPLE ACCESS SYSTEMS	016887/0516 026190/0812
12/01/2005	11/292,233; 7,817,754	M-ALGORITHM WITH PRIORITIZED USER ORDERING	017098/0162 026190/0812
04/10/2006	11/400,922; 7,783,110	SEMICOHERENT CHANNEL ESTIMATOR	017623/0177 026190/0812
08/10/2006	11/463,877; 7,613,228	M-ALGORITHM MULTIUSER DETECTOR WITH CORRELATION BASED PRUNING	018151/0479 026190/0812
09/15/2006	11/532,125; 7,593,492	COMBINATIONAL HYBRID TURBO-MUD	018272/0171 026190/0812
08/12/2009	12/539,691	METHOD FOR SIMULTANEOUS DETECTION OF A PLURALITY OF RFID TAGS USING MULTIUSER DETECTION	023099/0858 026190/0812
05/13/2010	12/742,686	MEDIA ACCESS CONTROL PROTOCOL FOR MULTIUSER DETECTION ENABLED AD-HOC WIRELESS COMMUNICATIONS	025578/0117 024673/0287 026190/0812
07/24/2003	10/626,146; 7,218,690	HYBRID TURBO-MUD FOR MULTIPLE ACCESS SYSTEMS	013859/0734 026190/0812
04/11/2002	10/120,955; 6,947,506	METHOD AND APPARATUS FOR IMPROVED TURBO MULTIUSER DETECTOR	013095/0631 026190/0812
01/23/2002	10/055,155; 6,839,390	VOTING SYSTEM FOR IMPROVING THE PERFORMANCE OF SINGLE-USER	012540/0669 024907/0140 026190/0812

		DECODERS WITHIN AN ITERATIVE MULTI- USER DETECTION SYSTEM	
11/12/2004	10/987,140; 7,350,136	VOTING SYSTEM FOR IMPROVING THE PERFORMANCE OF SINGLE-USER DECODERS WITHIN AN ITERATIVE MULTI- USER DETECTION SYSTEM	026190/0812
07/29/2002	10/208,409; 6,704,376	POWER AND CONFIDENCE ORDERED LOW COMPLEXITY SOFT TURBOMUD WITH VOTING SYSTEM	013020/0053 026190/0812
06/08/2004	10/863,081; 7,092,464	MULTIUSER DETECTION WITH TARGETED ERROR CORRECTION CODING	014778/0014 026190/0812
03/25/2002	10/105,918; 7,110,439	SYSTEM FOR DECREASING PROCESSING TIME IN AN ITERATIVE MULTI- USER DETECTOR SYSTEM	012744/0987 026190/0812
04/25/2003	10/423,695; 7,190,747	FREQUENCY MISMATCH COMPENSATION FOR MULTIUSER DETECTION	013676/0030 026190/0812
04/25/2003	10/423,740; 7,092,452	CO-CHANNEL INTERFERENCE RECEIVER	013674/0904 026190/0812
07/29/2002	10/207,490; 7,190,743	METHOD AND APPARATUS FOR OPTIMIZING TREE PRUNING IN A MULTIUSER DETECTOR	013198/0060 026190/0812
04/16/2003	10/414,738; 7,269,223	SYSTEM AND METHOD FOR INCREASING THROUGHPUT IN A MULTIUSER DETECTION BASED MULTIPLE ACCESS	013633/0069 026190/0812

		COMMUNICATIONS SYSTEM	
02/14/2005	11/057,479; 7,724,851	RECEIVER WITH MULTIPLE COLLECTORS IN A MULTIPLE USER DETECTION SYSTEM	016000/0309 026190/0812
04/29/2002	10/134,330; 6,981,203	METHOD AND APPARATUS FOR RANDOM SHUFFLED TURBO MULTIUSER DETECTOR	012877/0237 013129/0802 026190/0812
04/25/2003	10/423,655; 7,218,665	DEFERRED DECORRELATING DECISION-FEEDBACK DETECTOR FOR SUPERSATURATED COMMUNICATIONS	013633/0393 025710/0043 026190/0812
04/24/2003	10/422,340; 6,954,482	SOFT-DECISION TRELLIS-CODED DIFFERENTIAL FREQUENCY-HOPPED SPREAD SPECTRUM (DFHSS)	013643/0771 026190/0812
04/22/2005	10/482,598; 6,999,498	MULTIUSER DETECTION AIDED MULTIPLE ACCESS DIFFERENTIAL FREQUENCY-HOPPED SPREAD SPECTRUM	013904/0597 014293/0674 026190/0812 026193/0661
04/19/2004	10/827,462; 7,376,171	MULTIUSER DETECTION AIDED MULTIPLE ACCESS DIFFERENTIAL M-ARY CODING APPLICATIONS	014602/0733 026190/0812
09/10/2003	10/659,567; 7,236,546	PIPELINED TURBO MULTIUSER DETECTION	014002/0447 026190/0812
08/07/2001	09/923,709; 7,058,422	METHOD FOR OVERUSING FREQUENCIES TO PERMIT SIMULTANEOUS TRANSMISSION OF SIGNALS FROM TWO OR MORE USERS ON THE	012100/0995 026190/0812

		SAME FREQUENCY AND TIME SLOT	
08/31/2001	09/943,770; 6,947,505	SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS	012151/0553 026190/0812
04/16/2003	10/414,784; 6,985,699	EFFICIENT AND OPTIMAL CHANNEL ENCODING AND CHANNEL DECODING IN A MULTIPLE ACCESS COMMUNICATIONS SYSTEM	013633/0018 026190/0812
04/18/2002	10/125,241; 7,233,620	BANDWIDTH-EFFICIENT WIRELESS NETWORK MODEM	012670/0320 026190/0812
06/20/2002	10/176,011; 7,200,103	REDUCED ALGORITHM RECEIVER	013191/0058 026190/0812
06/20/2002	10/175,693; 7,139,334	COOPERATIVE CODE-ENHANCED MULTI-USER COMMUNICATIONS SYSTEM	013192/0370 013194/0865 026190/0812
08/26/2002	10/228,787; 6,947,502	PARAMETER ESTIMATOR FOR A MULTIUSER DETECTION RECEIVER	013198/0089 026190/0812
09/20/2002	10/251,187; 6,826,140	MULTICHANNEL DIGITAL RECORDING SYSTEM WITH MULTI-USER DETECTION	013147/0391 026190/0812
06/30/2004	10/497,557; 7,126,890	MULTITRACK READBACK AND MULTIUSER DETECTION FOR DISK DRIVES	014764/0397 014052/0594 026190/0812 026193/0661
08/27/2010	12/869,875	QR-RLS ADAPTIVE DIGITAL FILTER WITH 18-BIT PIPELINE ARCHITECTURE	024974/0911 026190/0812 026193/0661
04/20/2011	13/090,435	DISTRIBUTED SCHEDULER DESIGN FOR MULTIUSER	026155/0754 026190/0812 026193/0661

		DETECTION ENABLED WIRELESS MOBILE AD HOC NETWORKS	
01/31/2011	13/017,819	MULTIUSER DETECTION ENABLED MEDIUM ACCESS CONTROLE IN MOBILE AD HOC NETWORKS	026126/0450 026190/0812 026193/0661
02/23/2011	12/932,318	POWER AWARE SCHEDULING AND POWER CONTROL TECHNIQUES FOR MULTIUSER DETECTION ENABLED WIRELESS AD-HOC NETWORKS	025895/0099 026190/0812 026193/0661

The undersigned, acting as the Assignee, hereby revokes all prior powers of attorney, if applicable, and appoints the practitioners associated with the customer number 79683 as my/our attorney(s) or agent(s) to prosecute the patent(s) and/or patent application(s) and transact all business in the United States Patent and Trademark Office connected therewith.

By:

Jared Fry

Member, Collision Technology, LLC

Date:

8/13/2011

Electronic Acknowledgement Receipt	
EFS ID:	10732522
Application Number:	09943770
International Application Number:	
Confirmation Number:	2465
Title of Invention:	SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS
First Named Inventor/Applicant Name:	Rachel E. Learned
Correspondence Address:	Robert K. Tendler - 65 Atlantic Avenue - Boston MA 02110 US 6177237268 -
Filer:	Justin Robert Nifong
Filer Authorized By:	
Attorney Docket Number:	D-4557
Receipt Date:	15-AUG-2011
Filing Date:	31-AUG-2001
Time Stamp:	08:54:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
File Listing:	

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA_Collision_OliveLawGroup_20110812.pdf	3476082 a15fd5bbef4103df873fa8db61954b90f35cfa	no	6
Warnings:					
Information:					
Total Files Size (in bytes):			3476082		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/943,770	08/31/2001	Rachel E. Learned	D-4557

Robert K. Tandler
65 Atlantic Avenue
Boston, MA 02110

CONFIRMATION NO. 2465
POWER OF ATTORNEY NOTICE



OC000000049399054

Date Mailed: 08/22/2011

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/15/2011.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/vvan/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/943,770	08/31/2001	Rachel E. Learned	D-4557

CONFIRMATION NO. 2465

POA ACCEPTANCE LETTER

79683
OLIVE LAW GROUP, PLLC
125 EDINBURGH SOUTH DRIVE, SUITE 100
CARY, NC 27511



Date Mailed: 08/22/2011

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/15/2011.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/vvan/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:



Practitioners associated with the Customer Number:

114420

OR



Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:



The address associated with Customer Number:

114420

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Collision Communications, Inc.
20 Depot Street, Suite 2A
Peterborough, NH 03458

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	4/10/2013
Name	Jared Fry	Telephone	(857) 222-0690
Title	Co-Chairman, Collision Communications, Inc.		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt	
EFS ID:	16054736
Application Number:	09943770
International Application Number:	
Confirmation Number:	2465
Title of Invention:	SYSTEM FOR PARAMETER ESTIMATION AND TRACKING OF INTERFERING DIGITALLY MODULATED SIGNALS
First Named Inventor/Applicant Name:	Rachel E. Learned
Customer Number:	79683
Filer:	Theodosios Thomas/Jeanine Young
Filer Authorized By:	Theodosios Thomas
Attorney Docket Number:	234/29 UTIL
Receipt Date:	17-JUN-2013
Filing Date:	31-AUG-2001
Time Stamp:	12:09:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		C129_373_Statement.pdf	460867 2e21a4f6cc38391b4e7dff6d899f574983342 ccd4	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Assignee showing of ownership per 37 CFR 3.73.	1	2
	Power of Attorney	3	3
Warnings:			
Information:			
Total Files Size (in bytes):		460867	
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.			

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:	Customer No.: 114420
Inventor: Rachael Learned	Confirmation Number: 2465
Application Number: 09/943,770	Group Art Unit: 2634
Filed: 8/31/2001	Examiner: Erin M. File

For: System For Parameter Estimation And Tracking Of Interfering Digitally Modulated Signals

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

STATEMENT UNDER 37 CFR 3.73(b)

IN ACCORDANCE WITH 37 CFR 3.71(a), PROSECUTION OF THE PRESENT APPLICATION SHALL BE CONDUCTED BY THE ASSIGNEE, TO THE EXCLUSION OF THE INVENTOR(S).

Applicant, **Collision Communications, Inc.**, a Limited Liability Company, states that it is:

1. ☒ the assignee of the entire right, title, and interest; or
2. ☐ an assignee of less than the entire right, title, and interest
(The extent (by percentage) of its ownership interest is _____ %)

in the patent application identified above by virtue of an assignment from the inventor(s) to the current assignee as follows:

1. From: **Inventor(s)** To: **BAE Systems Information And Electronic Systems Integration Inc.**
The document was recorded in the United States Patent and Trademark Office at Reel / Frame: **012151 / 0553**, or for which a copy thereof is attached.
2. From: **BAE Systems Information And Electronic Systems Integration Inc.** To: **Collision Technology LLC**
The document was recorded in the United States Patent and Trademark Office at Reel / Frame: **026190 / 0812**, or for which a copy thereof is attached.

Additional documents in the chain of title are listed on a supplemental sheet.

As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to the Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature:  Date: 06.06.13
Theodosios Thomas
Reg. No. 45159, Patent Counsel, Phone No. 919-233-1942 x-203

STATEMENT UNDER 37 CFR 3.73(c)
(Supplemental Sheet)

3. From: **Collision Technology LLC** To: **Collision Communications, Inc.**

The document was recorded in the United States Patent and Trademark Office at Reel / Frame:
028490 / 0285, or for which a copy thereof is attached.



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/943,770	08/31/2001	Rachel E. Learned	

114420
Collision Communications, Inc.
5400 Trinity Road
Suite 303
Raleigh, NC 27607

CONFIRMATION NO. 2465
POA ACCEPTANCE LETTER



Date Mailed: 07/12/2013

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/17/2013.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/rmtturner myles/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/943,770	08/31/2001	Rachel E. Learned	234/29 UTIL

CONFIRMATION NO. 2465

POWER OF ATTORNEY NOTICE

79683
OLIVE LAW GROUP, PLLC
125 EDINBURGH SOUTH DRIVE, SUITE 100
CARY, NC 27511



Date Mailed: 07/12/2013

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/17/2013.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/rmtturner myles/

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