

Weekly Progress Report

Hiram McCall

Week ending 2-26-99

1. Telephone conversations with AGNC customers.
2. E-mail sent/received from AGNC customers, See attached.
3. Tasks accomplished during the week.

Reviewed and commented on CDNU simulator interim report.

Received maneuverability data from [REDACTED] for A98-030 collision avoidance. Obtained data for LPI data link and sent E-mail to Jack in Texas. Received and reviewed paper on over the horizon HF data link for collision avoidance.

MEMS design file due out before Bob leaves. The interim design file was sent to NC for checking and was modified Tuesday. The final version is ready to send out. I plan to send final version on Tuesday. The design of the dither sensing and drive circuitry is underway. Discussions were held with the packaging rep Michal Young. A number of packaging related issue have been raised through discussions with Bob.

1. Size, number of pins, sealing method. 2. What quality of clean room for packaging.
2. Vacuum sealing method. What solder and solder flux and how much out gassing. What type of vacuum pump and the amount of vacuum. What type and temperature for lid bonding.
3. Die attachment. What material is the die attached to. What is the die attachment material. What temperature during bonding. What outgassing from the bonding material.
4. Wire bonding. What bonding method. What temperature. What wire and what diameter. What quality of bond testing.

Rate sensor to be available by 5/9. The Mumps notebook was reviewed and the design steps taken by Bob was reviewed. The Cad tool was exercised and the file setup reviewed. The location and contents of all of Bob's files have been examined.

4. Business related contacts.

Neil Barber of Draper Labs for MEMS data.

5. Meetings/events attended. none

AGNC0003828

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001775

IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 3-5-99

1. Telephone conversations with AGNC customers.
2. E-mail sent/received from AGNC customers, See attached.
3. Tasks accomplished during the week.

Reviewed and commented on CDNU simulator interim report.

Dreydon Demonstration

Prepared slides for Dreydon demonstration.

Constructed interface description for demo setup Monday. Reviewed and practiced the interface setup for the Dryden demonstration.

MEMS development

- a) The final MEMS design file has been sent out.
- b) Along with the design file, a purchase order has been sent to MCNC for payment of the fabrication of Americangnc_3.cif.
- c) The design of the dither sensing circuitry is complete including spice simulations of the expected performance. This design includes the specification of the trans impedance amplifier op amp, drive circuit coupling capacitors, blocking capacitors, signal input resistors and sensing excitation signal source.
- d) A design with the sensing electronics included on the same substrate has been completed.
- e) Further discussions were held with the packaging rep Michael Young of ACSI concerning the cost, schedule, and availability of the packaging.
- f) A quote was obtained for the inclusion of circuitry into the package on the same substrate with wire bonding included. The quoted was very high for setup and for recurring cost, therefore the first prototype units will be packaged without internal circuitry.
- g) A dessicator is needed for the storage of the unused MEMS devices.

4. Business related contacts.

Janessa Raudenbush of MCNC for MEMS MUMPS purchase order.

Patricia Martinez of Elmo Semiconductor.

AGNC0003829
Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001776
IPR2024-00667, -00668
AGNC EX2024

T. J. Flure of Linear Technologies

Michael Young of ACSI (packaging)

5. Meetings/events attended. none

Weekly Progress Report

Hiram McCall

Week ending 3-12-99

1. Telephone conversations with AGNC customers.
2. E-mail sent/received from AGNC customers, See attached.

The second monthly progress report for A98-030 was sent to [REDACTED] at Fort Eustis Virginia. No attachment

3. Tasks accomplished during the week.
 - a) [REDACTED] [REDACTED] [REDACTED] [REDACTED] were contacted as potential digital designers.
 - b) Preparation for a trip to camp Pendleton CDNU on 3/17.
 - c) Discussion for tracker Ball Kalman Filter for JPL trip on 4/2
 - d) Discussion for Army [REDACTED] demonstration on PC 104
 - e) Timing robustness of the lab demo setup has to be enhanced using a different update rate for each piece of the simulation. The trajectory generator will set the time mark for all the other parts of the simulator. Ethernet will be used to link all communications between the processors with the addition of one Ethernet card. The rest of the processors will be sent a request for status by the trajectory generator in order to mediate timing and through put within the other elements of the the navigation and guidance and the IMU/GPS emulator. In order to make the simulation more realistic, the guidance computation will be made to depend upon the navigation computed trajectory rather than the true trajectory from the trajectory generator. If we were to be asked to provide plots or graphs to the customer, this would be a problem now.
 - f) As a result of discussion of the Eglin demo setup, the rack mounted PC is to be upgraded with one 450 Mhz Pentium III board.

MEMS development

- a) Received confirmation of the final MEMS design file acceptance has been obtained. The MEMS parts are due to be shipped on 5/3/99.
- b) The purchase order to MCNC has been confirmed for payment of fabrication of the rate sensor design.
- c) The preliminary design of the sensor pickoff circuitry is underway. Specification of the trans impedance amplifier op amp, and the demod circuitry is complete. Spice simulations should be complete by the end of next week.

AGNC0003831

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001778

IPR2024-00667, -00668
AGNC EX2024

- d) Confirmation of the packaging plan was discussed with the packaging rep Michael Young of ACSI.
- e) An interim alternate source of small rate gyros has been located.

4. Business related contacts.

Janessa Raudenbush of MCNC for confirmation of MEMS MUMPS purchase order.

Allen Cowan of MCNC for final status of MUMPS file submission

Linda of Newark Electronics for packaging information

[REDACTED] was called about Digital Design position

5. Meetings/events attended.

Demonstration on Monday at NASA Dreydon Edwards AFB

AGNC0003832
Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001779
IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 3-19-99

1. Telephone conversations with AGNC customers.

██████████ at Ft Eustis.

2. E-mail sent/received from AGNC customers. None

The statement of deliverables for A98-030 was sent by mail to the Administrative contract officer ██████████ in Van Nuys.

3. Tasks accomplished during the week.

- a) ██████████ ██████████ ██████████ ██████████ were contacted as potential digital designers.
- b) Equipment failure at camp Pendleton has delayed the planned trip for the CDNU.
- c) Discussions were held about the tracker Ball Kalman Filter for JPL trip on 4/2.
- d) A search is underway for a 450 Mhz Pentium III board for support of the lab simualtion setup and the Eglin trip.
- e) Information is being gathered about a digital cell phone for constructing a demo of an integrated GPS and cell phone. Two suppliers are to send an interface description next week.

MEMS development

- a) Received confirmation that the final MEMS design file acceptance has been obtained. The MEMS parts are due to be shipped on 5/3/99.
- b) A preliminary parts list and schematic is being prepared for the sensor pickoff circuitry. A preliminary design, shematic, board layout and parts list are complete for the sensor to digital converter. A parts list, schematic, and board layout are being prepared for the trans impedance amplifier and demod circuitry. The sensor to digital converter is applicable to many types of rate gyros, including the MEMS and the alternate.
- c) A specification and top level SW design of the high speed processing for the accel and gyro data has been completed.
- d) A few of the parts have been obtained for the sensor to digital convertor.

4. Business related contacts.

AGNC0003833

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001780

IPR2024-00667, -00668
AGNC EX2024

[REDACTED] at Ft Eustis.
[REDACTED] of TRW

5. Meetings/events attended. none

**RESTRICTED - ATTORNEYS' EYES
ONLY**

AGNC0003834
Restricted - Attorneys' Eyes Only

AGNC_NIN0001781
IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 5-21-99

1. Telephone conversations with AGNC customers.

[REDACTED] at Ft Eustis. He confirmed receipt of the monthly report.
[REDACTED] confirmed receipt of the monthly status report.

2. E-mail sent/received from AGNC customers.

To [REDACTED], The Phase I ARMY UAV monthly report.
To [REDACTED], the Marine Corp Monthly status report

3. Tasks accomplished during the week.

- a) Released the ARMY UAV monthly report.
- b) The UAV final report is being prepared for release next week.
- c) The Marine Corp Navigation simulation has been started.
- d) Windows CE has been ordered and should arrive next week.
- e) Preparation is underway for the Eglin Demo.
- f) Another IRQ card is due to be arriving next week.

g) **MEMS development**

1. The MEMS devices have arrived from MCNC. They are to be shipped to Irvine for packaging next week.
2. The drive circuitry schematic for the MEMS devices is being generated and should be completed next week.
3. The Micro IMU digital interface circuit board layout and file submission has been completed. The board should arrive Monday or Tuesday.
4. The Parts to populate the digital interface board were ordered and received.

1. Business related contacts.

[REDACTED] at Ft Eustis.

AGNC0003840
Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001787
IPR2024-00667, -00668
AGNC EX2024

[REDACTED] of General Dynamics.

2. Meetings/events attended. none

**RESTRICTED - ATTORNEYS' EYES
ONLY**

AGNC0003841
Restricted - Attorneys' Eyes Only

AGNC_NIN0001788
IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 6-4-99

1. Telephone conversations with AGNC customers.

none

2. E-mail sent/received from AGNC customers.

██████████ sent E-mail giving some explanation about the interfaces to the seen at the Eglin PRIMES test setup. An E-mail was sent to ██████████ acknowledging receipt of his E-mail.

3. Tasks accomplished during the week.

- a) The land nav odometer model has been tailored for use by the Marine Corp Navigation simulation.

- b) Upon receiving the Windows CE development tool, WinDK, it was discovered that an additional set of software was needed. This was ordered and arrived Friday. The work station is being setup for use during next week for coding of the micro IMU.

- c) Preparation is underway for the trip to JSC Houston and to Ft Eustis.

- d) A quote was obtained for a Xilinx FPGA development workstation.

- e) **MEMS Micro IMU development**

1. The MEMS are due to be completed on the 22th of June.
2. The driver and phase lock loop circuitry schematic for the MEMS device is been prepared.
3. The Micro IMU digital interface circuit board was checked out in good working order. The PC hosted interrupt handler has been completed and checked out.
4. The reference, restoring switches, A/D converters and analog buffer amps were checked out on the micro IMU.
5. The detailed software requirements including the interface definition was completed for the high speed (2000 HZ) portion of the micro IMU software.
6. Coding has begun for the high speed processing portion of the micro IMU using the Windows CE development work station.

AGNC0003844

Restricted - Attorneys' Eyes Only

**RESTRICTED - ATTORNEYS' EYES
ONLY**

AGNC_NIN0001791

**IPR2024-00667, -00668
AGNC EX2024**

7. A portion of the code for Demo display of the micro IMU outputs has been obtained.

1. Business related contacts.

Phil Arnold of HP
Xilinx in Agoura Hills

2. Meetings/events attended. none

AGNC0003845
Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001792
IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 7-2-99

1. Telephone conversations with AGNC customers.

██████████ of NASA JSC asked many questions about the phase II
██████████ MEMS proposal. These questions were about the length of time
in the MEMS business and how many years in the IMU business.

2. E-mail sent/received from AGNC customers.

none.

3. Tasks accomplished during the week.

- a) The land nav odometer model has been tailored for use by the Marine Corp Navigation simulation.

b) **MEMS Micro IMU development**

1. Searched for a GFE rate table and flux valve.
2. Ordered new surface mount accel chips from Analog Devices.
3. The sixteen MEMS rate sensors have been packaged and one unit has a vacuum leak. This one was sent to JSC for their use.
4. Surface mount breadboard has been obtained for use for the MEMS device driver circuitry breadboard circuitry.
5. The Micro IMU digital interface circuit board pulse rebalance amplifier gains for the gyros were calibrated. The accel pulse rebalance amplifier gains are being calibrated next week.
6. The first 5 min sums were obtained this week for the gyro circuitry with good results. The drift is less than .1 deg/hr.
7. The detailed software requirements low speed (62.5 HZ) portion of the micro IMU software have been completed.
8. Coding has been completed for the high speed processing portion of the micro IMU.
9. An AHRS Demo display code in basic has been obtained.
10. A small Windows CE demo program has been written and run on the PC 104. Windows CE is critical to the running of the 62.5 Hz processing on the Amprom board.
11. Calibration techniques have been devised and a cal procedure has been written for use in calibrating the Gyro SF, Accel SF, Accel Bias, Gyro Bias, Gyro and accel Misalignments.

AGNC0003846

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001793

IPR2024-00667, -00668
AGNC EX2024

1. Business related contacts.

None

2. Meetings/events attended.

Trip to Eglin AFB to meet with [REDACTED] for the Phase II Dual IMU simulation and the phase II EMI. Meeting with [REDACTED] [REDACTED] about future use of the micro IMU on the [REDACTED] program and the [REDACTED] program.

AGNC0003847

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001794

IPR2024-00667, -00668

AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 7-9-99

1. Telephone conversations with AGNC customers.

none

2. E-mail sent/received from AGNC customers.

An explanation for the bulk vs surface machined MEMS was sent to [REDACTED] at NASA JSC.

3. Tasks accomplished during the week.

- a) Phase II quarterly report was sent to [REDACTED] at Eglin AFB.

b) **MEMS Micro IMU development**

1. Located rate table information and flux valve chip.
2. A detailed schematic and parts list for the MEMS sensors capacitive pickoff circuit has been completed. The drive circuitry for the breadboard test interface has been designed.
3. The Micro IMU digital interface circuit board pulse rebalance amplifier gains for the accel were calibrated.
4. The first 5 min sums were obtained this week for the accel circuitry with good results. The drift is less than .1 milig/hr. These were obtained after finding a few more software bugs in the low level or high speed processing SW requirements.
5. Integration of the Windows CE Code and low level interrupt handler code has begun. This should be completed next week.
6. An additional AHRS Demo display has been obtained and is being integrated into the Win CE operating kernal.
7. Vertual C++ code is needed for four types of interfaces: RS232, Ethernet, USB, and parallel port. This code is to be obtained from the extensive Win CE users libraries from the net.
8. A draft micro IMU short product specification has been prepared.

1. Business related contacts.

None

2. Meetings/events attended.

AGNC0003848

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001795

IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 7-30-99

1. Telephone conversations with AGNC customers.

██████ of Wright Patterson AFB called to request test data for the gyro and to schedule a visit here. Tasso answered the request.

2. E-mail sent/received from AGNC customers.

██████████ of Eglin AFB was sent an E-mail to inform him that no ████████ documents nor a ████████ IMU had been received.

3. Tasks accomplished during the week.

- a) The Rate Table PO has been sent to Robert Brams.

b) **MEMS Micro IMU development**

1. The mechanical design of the uIMU block was completed and the preliminary drawings were faxed to the machine shop. The completed subassembly should be ready Monday.
2. The Altera FPGA programming tool set was due to arrive Friday, but has been delayed until Monday.
3. The digital interface board schematic conversion to an FPGA VHDL design file was completed.
4. The VHDL design was tested in the FPGA simulation tool.
5. The 62.5 Hz AHRS mechanization code was completed and is undergoing module testing.
6. The power supply isolation circuitry has been completed and is ready for testing.

1. Business related contacts.

Robert Brams of BMI

2. Meetings/events attended.
None

AGNC0003849

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001796

IPR2024-00667, -00668
AGNC EX2024

Weekly Progress Report

Hiram McCall

Week ending 10-29-99

1. Telephone conversations with AGNC customers.

██████████ of ARDEC. He will be here Friday for a demo of our unit.
He is interested in as many as 10,000 units.

2. E-mail sent/received from AGNC customers.

none

3. Tasks accomplished during the week.

- a) Tanner was contacted about fabricating an analog ASIC. They have agreed to deliver 1000 parts by the 1st of March if we can submit a schematic by the 19th of November. Total price to be \$16,000. We will also submit our own version of a two ASIC design to the foundry for fabrication by March 1st.
- b) Ed Prebahalla of Carco has promised to send schematics about the MPACS panel in the rate table controller assembly.
- c) The MEMS provisional patent was reviewed and found to need additional changes in the description of the dither drive mechanism and the retorquing circuit.
- d) MEMS Micro IMU development
 1. A new FPGA circuit card was assembled and combined with rest of the circuit cards.
 2. A new set of circuit cards for the micro IMU were assembled with the gyro and accel sensors.
 3. The new gyro and accel sensor circuit cards were combined with the other circuit cards and tested as a unit.
 4. The modified S/W interface was tested and found to be in good working order. This eliminates the need to close the rebalance loop from outside software.
 5. An export license application was completed for the uIMU.

1. Business related contacts.

none

2. Meetings/events attended.
CIGTF personnel were here on Thursday.

AGNC0003859

Restricted - Attorneys' Eyes Only

RESTRICTED - ATTORNEYS' EYES
ONLY

AGNC_NIN0001806

IPR2024-00667, -00668
AGNC EX2024