revelHMI

Next-Generation Haptic Technology to Radically Improve Electronic Devices

Robin Elenga, CEO and Founder - robin@revelhmi.com

Resonant Systems Ex. 2002
Nintendo v. Resonant Systems, IPR2025-01098
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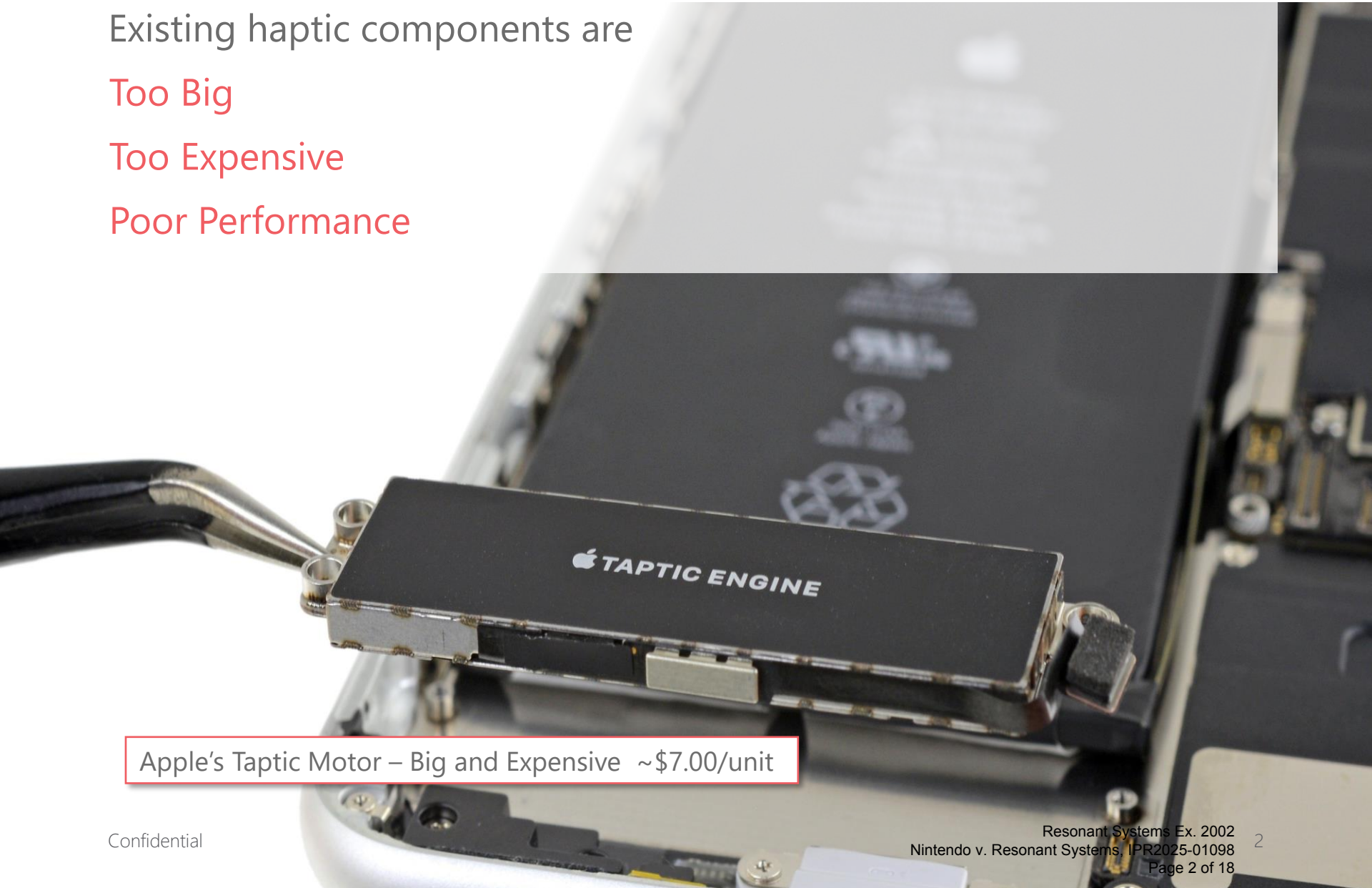
Problem

Existing haptic components are

Too Big

Too Expensive

Poor Performance



Apple's Taptic Motor – Big and Expensive ~$7.00/unit

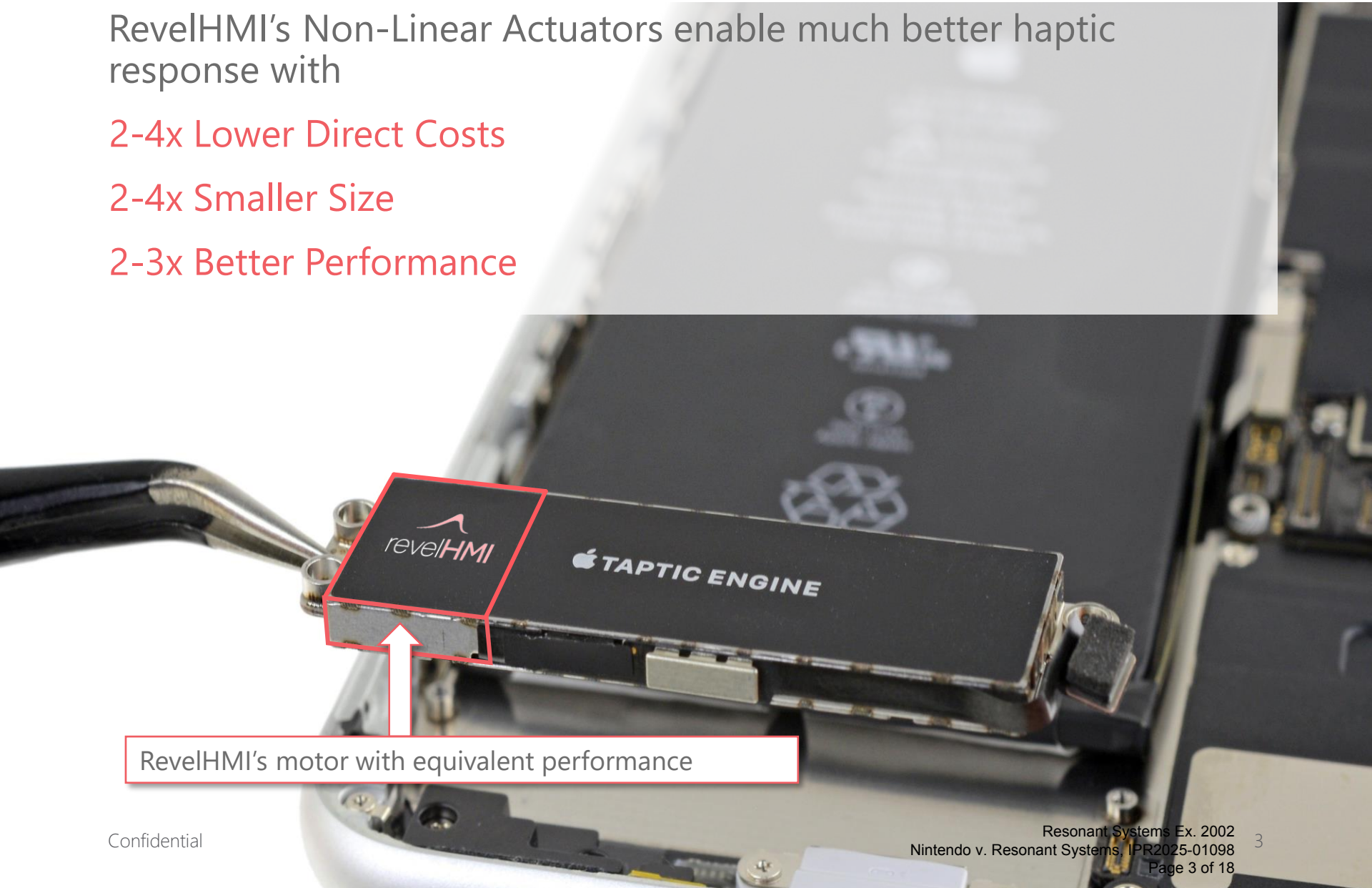
Solution

RevelHMI's Non-Linear Actuators enable much better haptic response with

2-4x Lower Direct Costs

2-4x Smaller Size

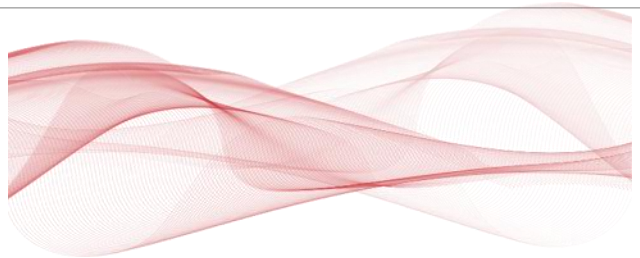
2-3x Better Performance



RevelHMI's motor with equivalent performance

Vision

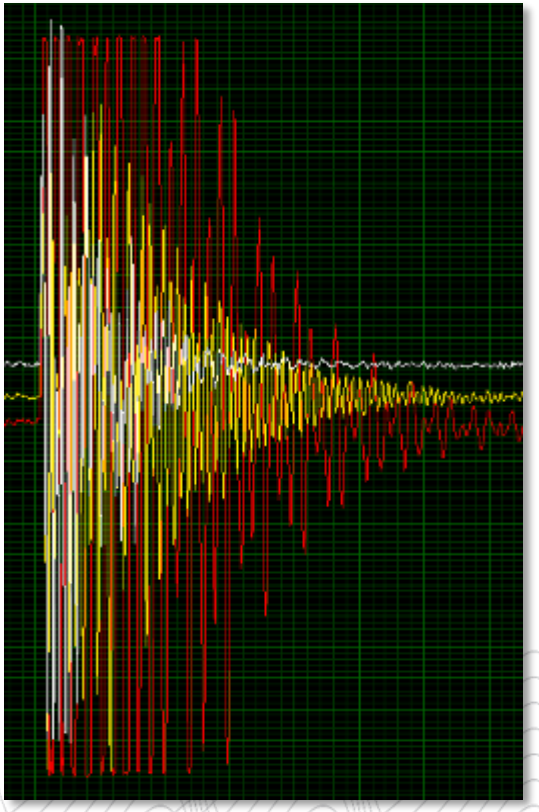
RevelHMI is developing the next-generation haptic interface

	State-of-the-Industry	RevelHMI Vision
	Simple Vibration	 High-Definition Vibration Patterns
Mobile	Buzzer alerts user of an issue, but provides no information about the issue	Haptic Language device intuitively communicates information to user
Gaming	Buzzer notifies player that they touched an object, but all objects feel the same	Haptic Feedback that feels like “the real thing” creating immersive experience

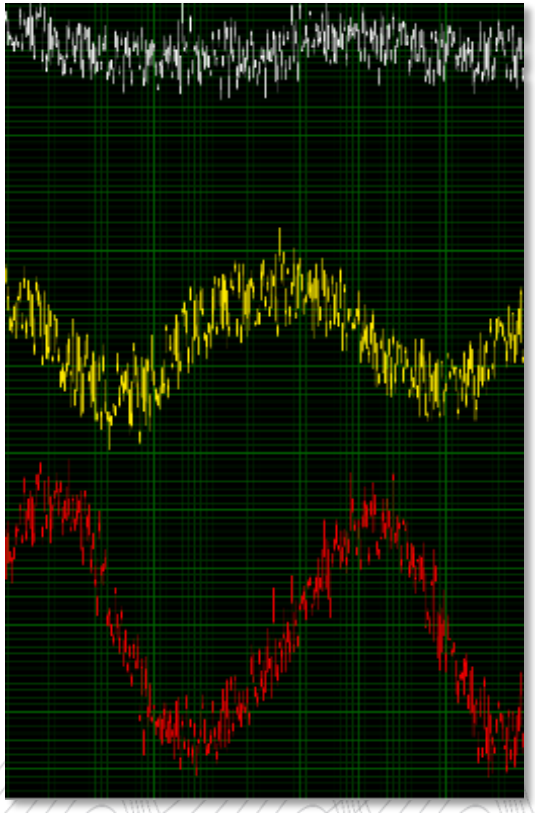
Vision: Immersive Gaming

Requires Better Hardware, Drivers, APIs and Content

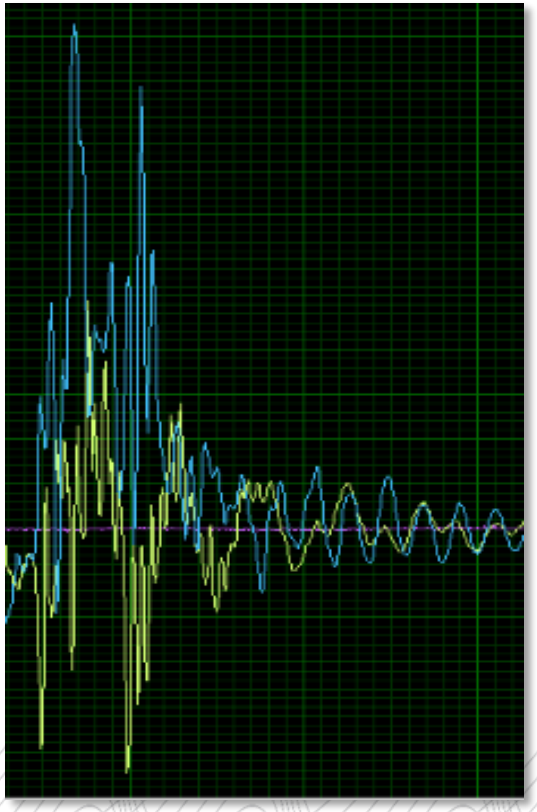
Reality is Complex



Current Haptics are Primitive



RevelHMI's Improved Haptics



RevelHMI's Non-Linear Resonating Actuator

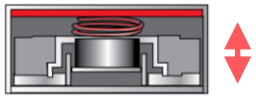
A vibration motor to enable next-generation haptic performance in wide range of devices with industry leading

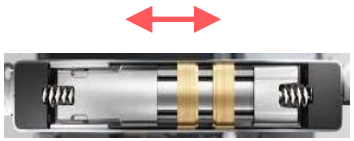
- Performance
- Reliability
- Cost/Performance
- Size/Performance

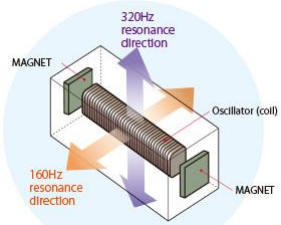
Highly-Tunable to support specific product requirements

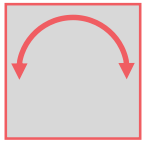
- Power/Hz/Efficiency
- Size
- Drive Signal/Driver Topography

Resonating Actuator Technologies







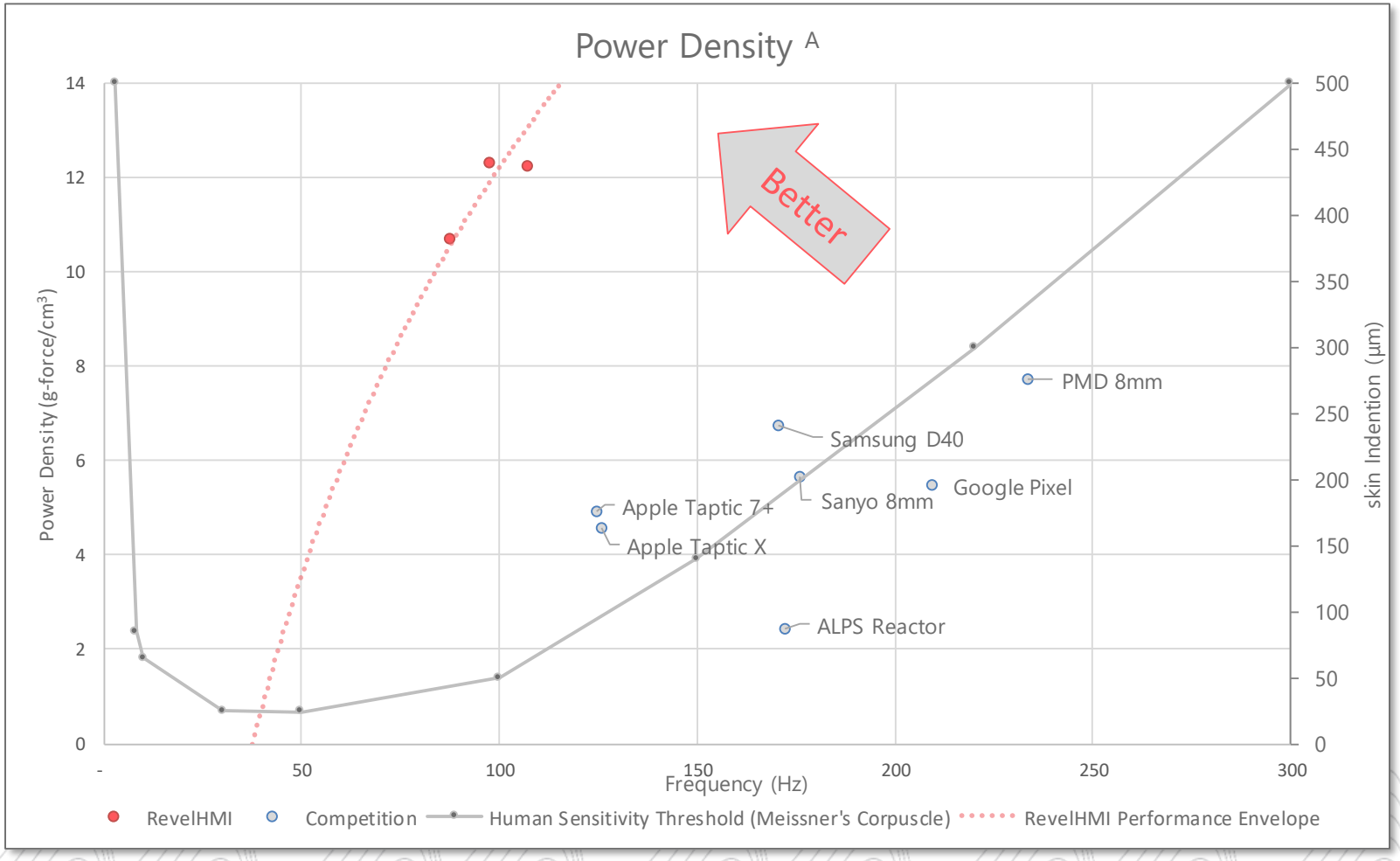


	LRA	AAC Taptic	ALPs Reactor	RevelHMI
Path	Linear (Z-Axis)	Linear (X-Axis)	Linear (2-Axis)	Arc (2-Axis)
Mass	Small	Large	Large	Small
Distance	Small	Small	Small	Large
Kinetic Energy	Low	Medium	Medium	High
Losses	High	High	Medium	Very Low
Power	Low	Medium	Medium	High
Efficiency	Low	Low	Low	High
Hz	> 200Hz	> 110Hz	160Hz & 320Hz	50Hz and up
Size	Min Height: 3mm	Very Large	Very Large	Smaller / Flexible
Models	Many	Small Number	1	Infinite

RevelHMI's Secret Sauce: we move a smaller mass further, in a smaller space with less losses, to generate more kinetic energy.

Disruptive Performance

Allows solutions that operate where humans are more sensitive



Legend: (A) More is Power Density is better, and Lower Frequencies are easier to feel and more difficult to achieve

Performance

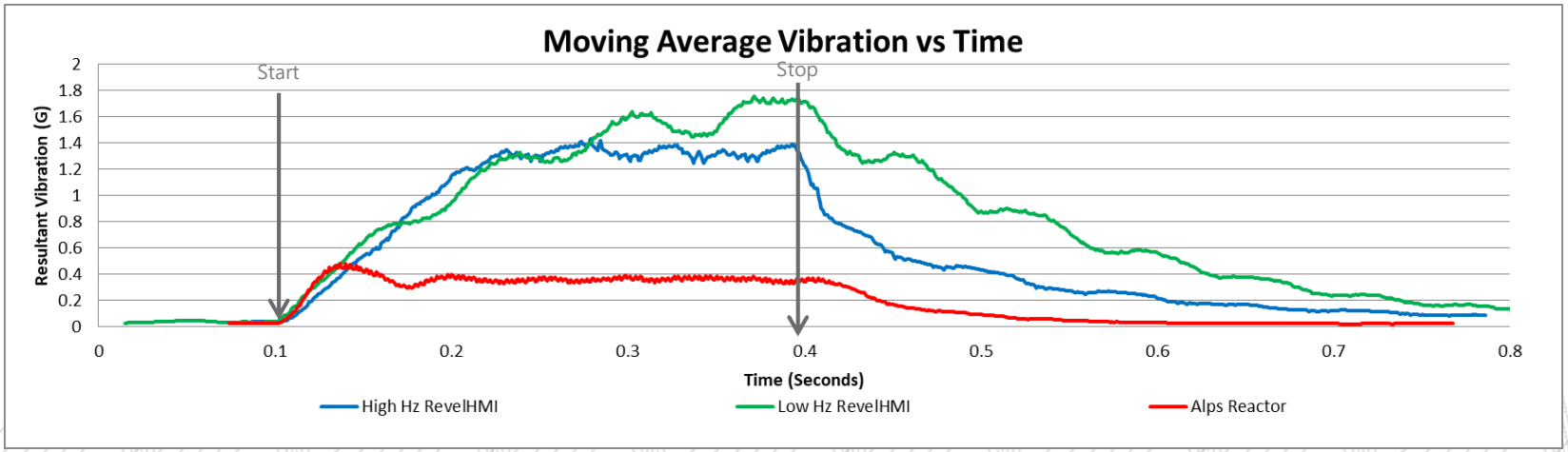
ALPs Reactor versus RevelHMI's latest samples

	Size (mm^3)	Frequency (Hz)	Vibration Power (G)	Input Power (W)	Power Density (G/cm^3)
RevelHMI	400	107	4.9	0.46	12.3
ALPs Reactor	**2,124**	**172**	**5.2**	**0.62**	**2.5**
RevelHMI	400	140	6.7	0.38	16.7
RevelHMI	800	153	9.6	0.39	12.0
RevelHMI	800	98	9.9	0.66	12.3
RevelHMI	1,200	88	12.9	0.38	10.7
RevelHMI	1,200	173	15.8	0.38	13.2

Rise-Time / Fall-Time Performance

Without driver assisted waveforms

	Rise-Time: 0 to 50% (ms)	Rise-Time: 0 to 100% (ms)	Fall-Time: 100 to 50% (ms)	Fall-Time: 100 to 10% (ms)
Alps Reactor	12.5	36	36	113
RevelHMI - High Hz	55	88	39	210
RevelHMI - Low Hz	72	178	133	243
RevelHMI – High Hz (With Damper)	~18	~29	~13	~70
RevelHMI - Low Hz (With Damper)	~24	~59	~44	~81



Demos

Product

A complete solution to enable next-generation haptics

revelHMI

New Non-Linear Actuator Technology
Industry-leading vibration performance in every category allowing a smaller actuator with lower costs

Advanced Haptic Motor Drivers
Dramatically better performance in a lower cost component that can be integrated inside actuator

Haptic Content & Development Tools
Tools and content to enable better haptic systems

Professional Services
Rapid product-optimized solution development and deployment

Team

We have the background, skills and vision to succeed

Robin Elenga, CEO
Multiple Startups, EDS, Accenture, Deloitte Consulting

Murray Vince, Biz Dev
Intellectual Ventures, Microsoft, Apple

Dan Knodle, Dev Lead
Iota, Trillium, SpaceLabs, Cascadia Technology

Steve Meginniss, Advisor
Inventor Sonicare, Clarisonic, Magic Wheels

Chris Howard, ME
Mechanical Design, Mechatronics, Robotics

Craig Eisler, Haptic APIs
Microsoft DirectX Developer, Kinect, Xbox Live

Steve Combest, Testing
Electromagnet design and Testing

Dave Beecher, EE
BLMC design and optimization, embedded software

Board of Directors

Paul Cole – T-Mobile, Swype, VoiceStream, Western Wireless
Chris Phillips – GM Server and Azure Division, MSFT
Carl Lombardi – Spacelabs CEO, Multiple Startups
Laurie Lyford – Private Investor
Robin Elenga – CEO

Services / Capabilities

Strong Value Proposition

Motor Development

- Internal / External Actuation
- Low-Q / High-Q
- PWM / Sine-drive
- Impulse / Vibration

Driver Tuning

- Driver Selection / Optimization

Testing and Optimization

- Performance
- Life Testing

Delivery Support

- Vendor Validation
- DFM Management
- Quality Systems / Reporting

Professional Services

Faster Development

- Size/Hz/Power Constraints Removed
- Rapid Design / Optimization
- Rapid Prototype Delivery

Better Solution

- Smaller, Much Better Performance
- Better Quality
- Better Reliability

Patent Protected

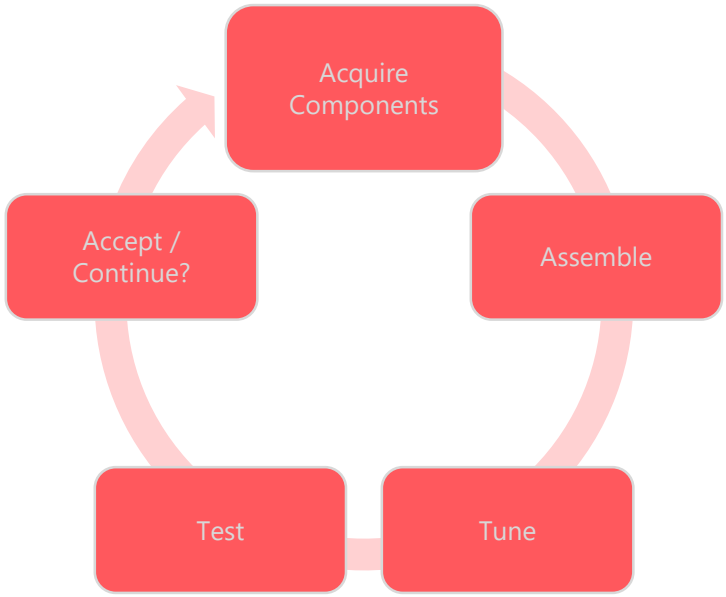
- 6 Utility Grants
- Multiple Office Actions
- Multiple in Process

How can we help?

- Q&A

Development Model

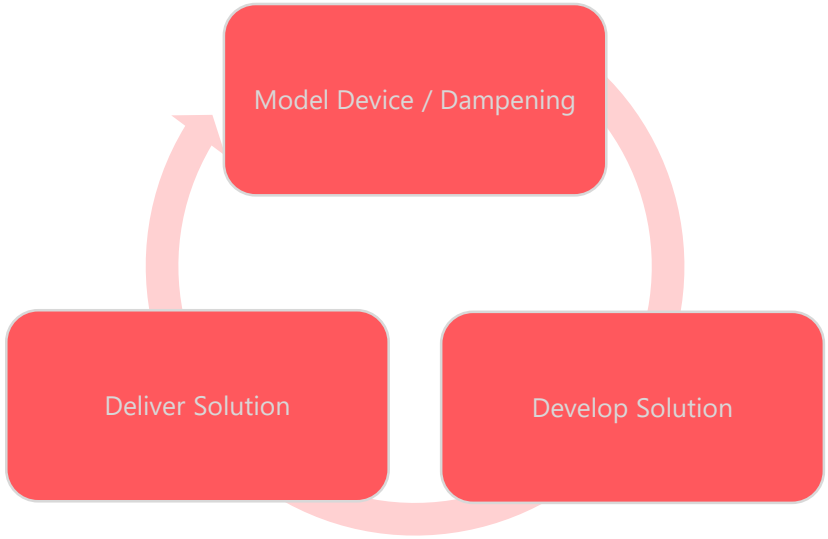
Status Quo - Component Sales



Acceptable (Satisficed) Solution

- Development: Slower / Riskier
- Performance: Compromised
- Solution: Bigger / More Expensive

RevelHMI – Mass Customization



Optimized Solution

- Development: Faster
- Performance: Goals Met
- Solution: Lower Costs / Smaller

History

Deep Vibration Technology Domain Experience

sonicare

clarisonic

revelHMI

2000 2005 2010 2015

revel body

IP Status

Granted

- 8,093,767 - Linear-resonant vibration module - USA
- 8,860,337 - Linear vibration modules and linear-resonant vibration modules - USA
- 9,369,081 - Linear vibration modules and linear-resonant vibration modules - USA
- 9,768,674 - Printed-circuit board motor - USA
- 9,941,830 - Linear vibration modules and linear-resonant vibration modules - USA
- 11201601118W – Printed-Circuit Board Motor - Singapore

Office Action

- 14843684.3 - PRINTED-CIRCUIT BOARD MOTOR – Europe
- 2,922,566 - PRINTED-CIRCUIT BOARD MOTOR – Canada
- 15/043,584 - Oscillating-Resonant-Module Controller - USA
- 201680009731.X - Oscillating-Resonant-Module Controller – China
- 62/509,644 – Efficient Haptic Actuator

Waiting for Prosecution (partial list)

- CN105765834A - PRINTED-CIRCUIT BOARD MOTOR – China
- P-00201602364 - PRINTED-CIRCUIT BOARD MOTOR – Indonesia
- 2016-542859 - PRINTED-CIRCUIT BOARD MOTOR – Japan
- 2016-7008110 - PRINTED-CIRCUIT BOARD MOTOR – Korea
- PI2016700845 - PRINTED-CIRCUIT BOARD MOTOR – Malaysia
- TBD - Oscillating-Resonant-Module Controller – Europe
- TBD – High-Performance Haptic Actuator - PCT