Welcome…We Will Begin Momentarily

HIMSS
transforming health through information and technology™

The HIMSS Innovation Community April 22, 2019 event will begin at the top of the hour.

- **Visit the HIMSS Innovation Community at *http://www.himss.org/innovation***
- ***Visit our HIMSS Innovation Community Sponsor NewWave at https://newwave.io***
- ***Follow us on Twitter: #Aim2Innovate***

Future of Healthcare: Driving Innovation through Advanced Sensors and Flexible Technology

April 22, 2019

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INNOVATION COMMUNITY

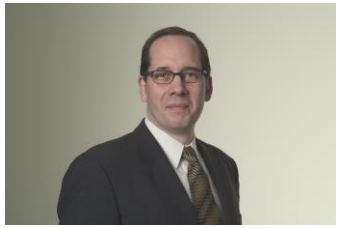
Agenda

- Welcome
- HIMSS Innovation Community Updates / Announcements
- Presentation:
  - “Future of Healthcare: Driving Innovation through Advanced Sensors and Flexible Technology”
- Q&A
- Wrap-Up / Next Steps

Welcome

Panelist:
Scott Miller, PhD
Director of Strategic Programs
NextFlex

Panelist:
Emily McGrath
Deputy Director, Workforce Development
NextFlex



Rod Piechowski
Senior Director,
HIMSS

Moderator:
Ian E. Hoffberg
Applied Innovation Manager,
HIMSS

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Updates / Announcements

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HIMSS Innovation Community

- Healthcare leaders sharing stories of innovation
- Domain expertise, leadership, guidance and collaboration

www.himss.org/innovation

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Thank You!
HIMSS Innovation Community Sponsor

NewWave merges innovation, precision and compassion, empowering our clients to use technology in new ways as they solve problems for the greater good.

NewWave is an information technology company helping businesses and government agencies modernize and thrive by applying the power of technology.

To learn more please visit their website at www.newwave.io

Events

Patient Experience: Empathy + Innovation Summit

May 13-15, 2019 | Cleveland, OH

Use discount code "INNOVATE" to get $200 off registration fees.

*Note: Discount code only applicable for regular attendee category for full 2-day pass; not applicable for 1-day passes.

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Events

Machine Learning & AI for Healthcare

June 13-14, 2019 | Boston, MA

Keynote Speakers

AMY COMPTON-PHILLIPS

Executive Vice President and Chief Clinical Officer

Providence St. Joseph Health

ANTHONY CHANG

Chief Intelligence and Innovation Officer

CHOC Children

HIMSS

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Announcement

Seeking Tech Solutions to Improve Health Equity for Latinx Youth

Solutions will be accepted until ***April 26, 2019***, and finalists will be announced ***May 5, 2019***. Learn more and submit your solution.

Submitting your innovative solutions that:

- Rooted in authentic understanding of and experience in local settings
- Bridge the gaps between community members and products, services, information, institutions and/or groups that could improve Latinx adolescent and young adult health outcomes
- Forward-thinking, leveraging upcoming and future technology trends

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Podcasts

Episode #52: Meet the Winners: Cleveland Clinic's 2018 Medical Innovation Summit

Episode #51: A Conversation about Social Determinants of Health

Episode #50 Digital Strategy for Healthcare Providers

Episode #49: Welcome to the revolution: Transforming the Healthcare Industry

Episode #48: Innovation Driving Work Force Development

NEXTFLEX AND FLEXIBLE HYBRID ELECTRONICS FOR DIGITAL HEALTH DATA COLLECTION & ADVANCED MEDICAL DEVICES

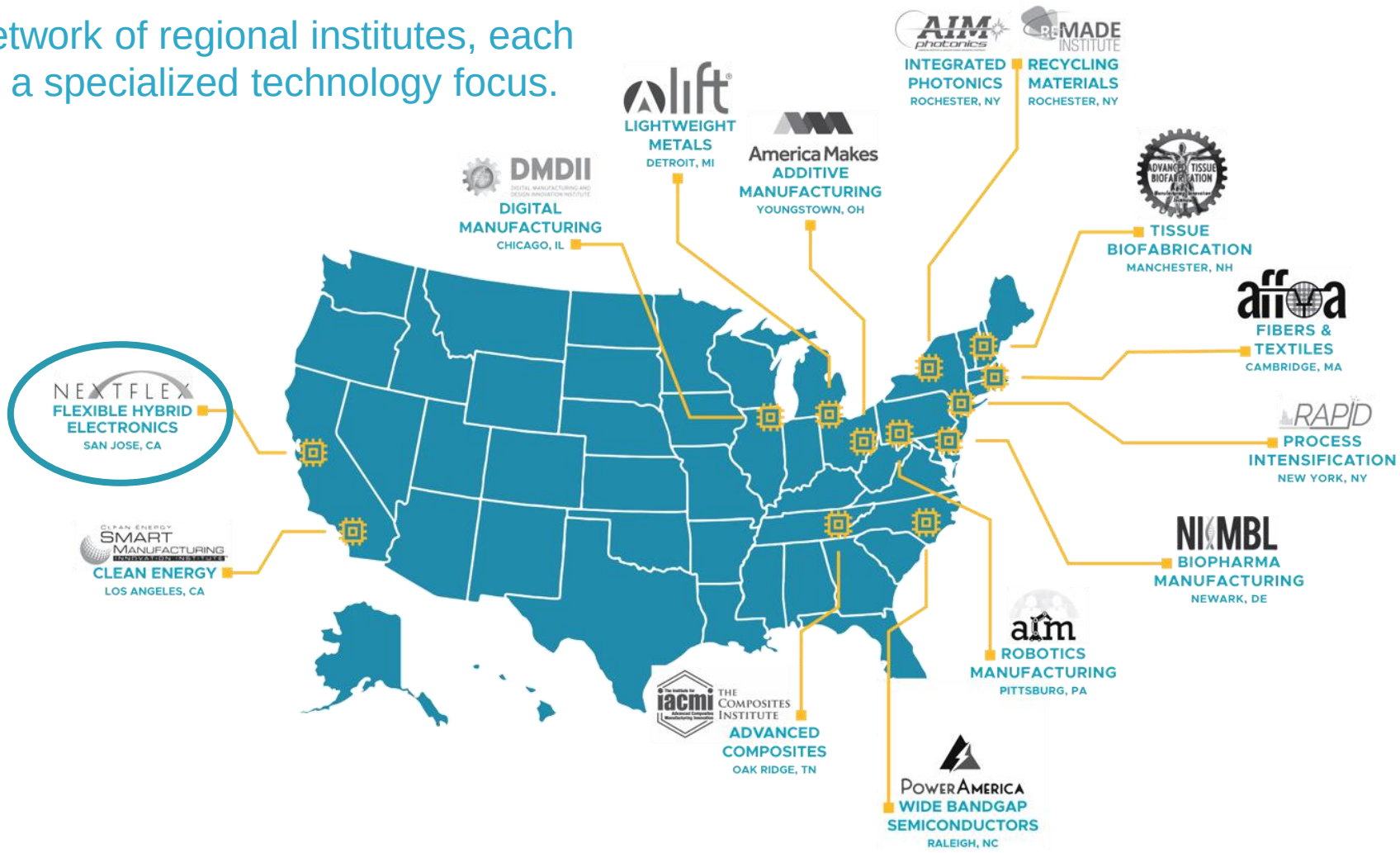
DR. SCOTT MILLER & EMILY MCGRATH
DECEMBER 23 | 2019

WHAT IS NEXTFLEX?

A National Network

Manufacturing USA

A network of regional institutes, each with a specialized technology focus.



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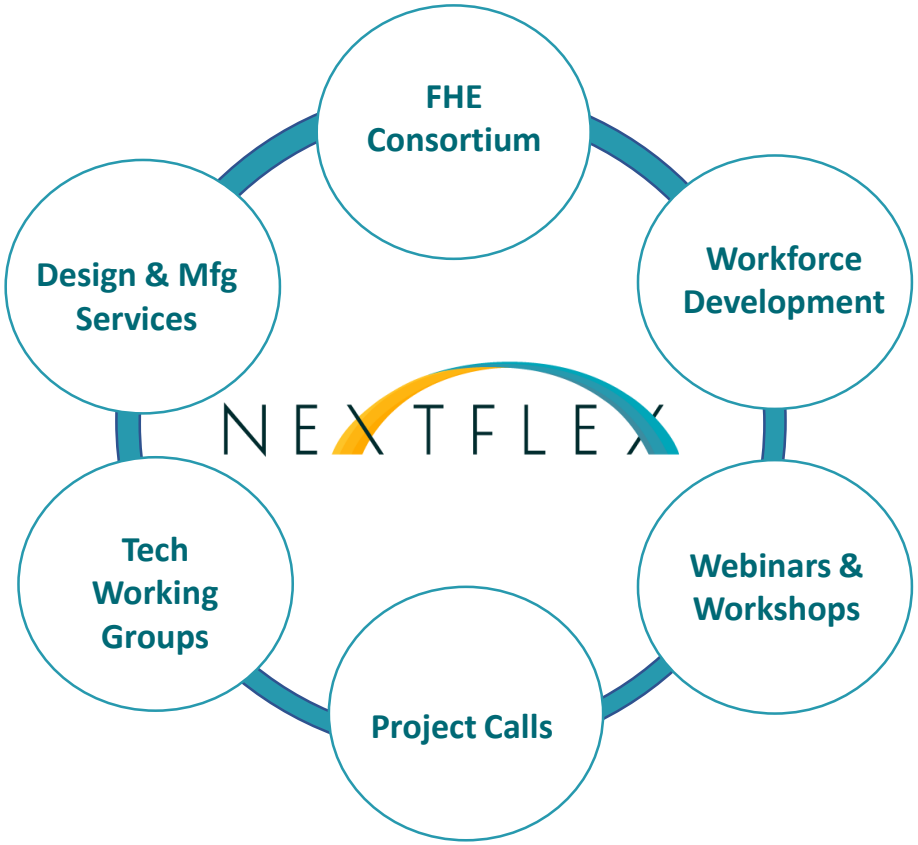
Industry Consortium



Established	28 August 2015
Hub Location	San Jose, California
Proposal Contributors	145+ in 27 states
Federal Funding	$75 million over 5 years
Committed Matching	$96 million
Government Agencies Engaged	17 DOD & OGAs

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A National Network

March 21, 2019

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NextFlex Nodes

NextFlex Nodes in NY and MA formed in 2018

March 21, 2019

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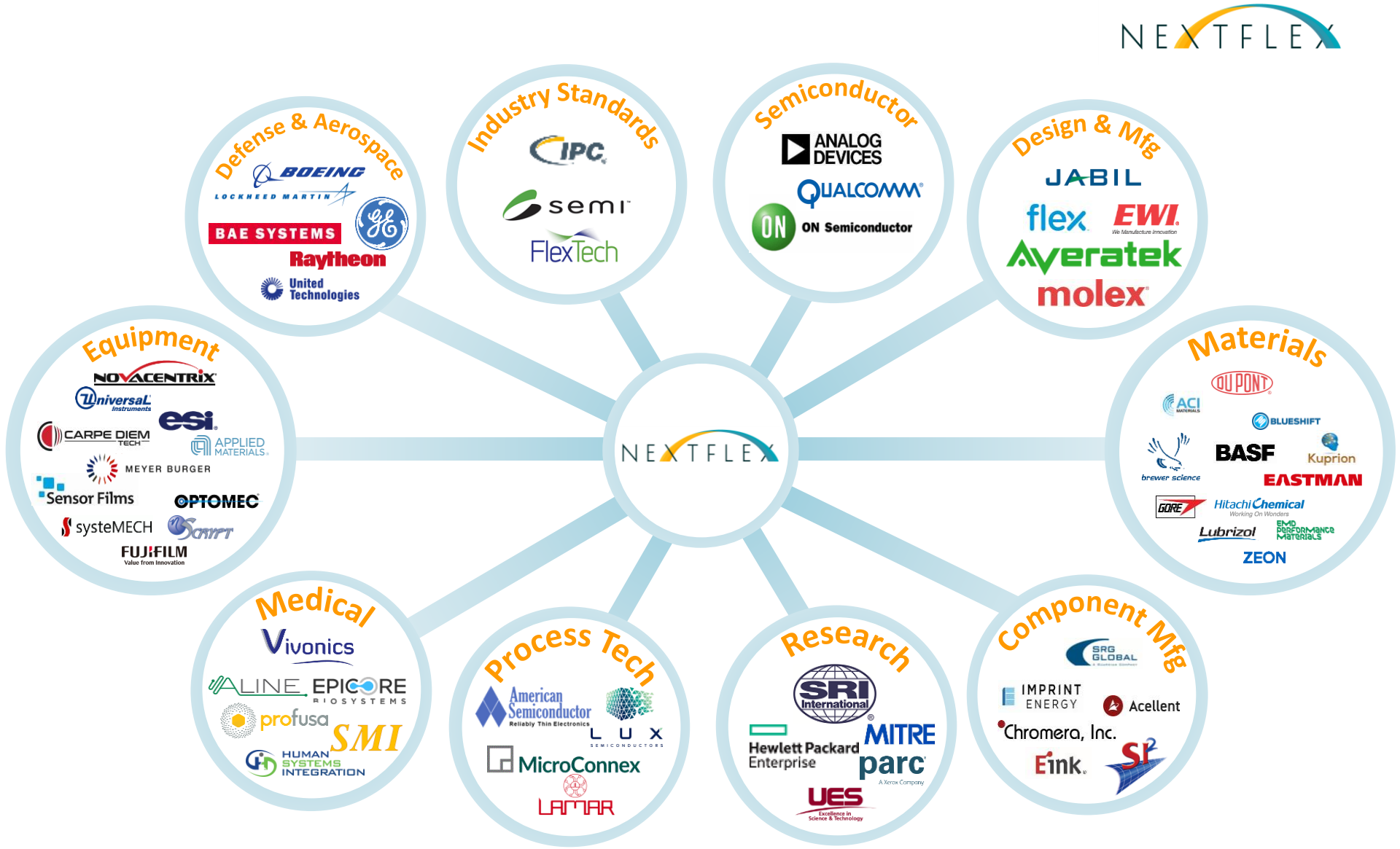

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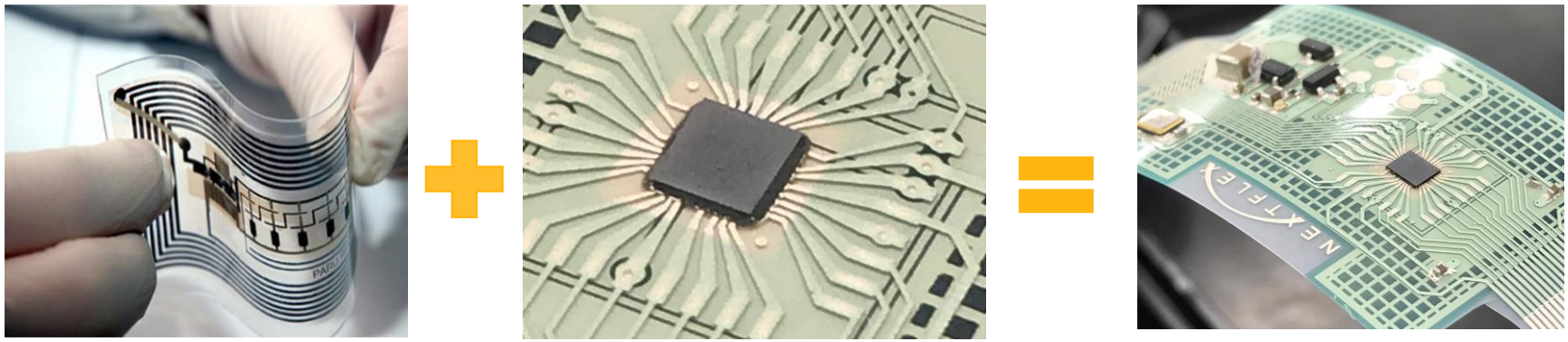
WHAT IS FHE?

Flexible Hybrid Electronics

FHE (Flexible Hybrid Electronics) combines the flexibility and low cost of printed plastic film substrates with the performance of semiconductor devices to create a new category of electronics.



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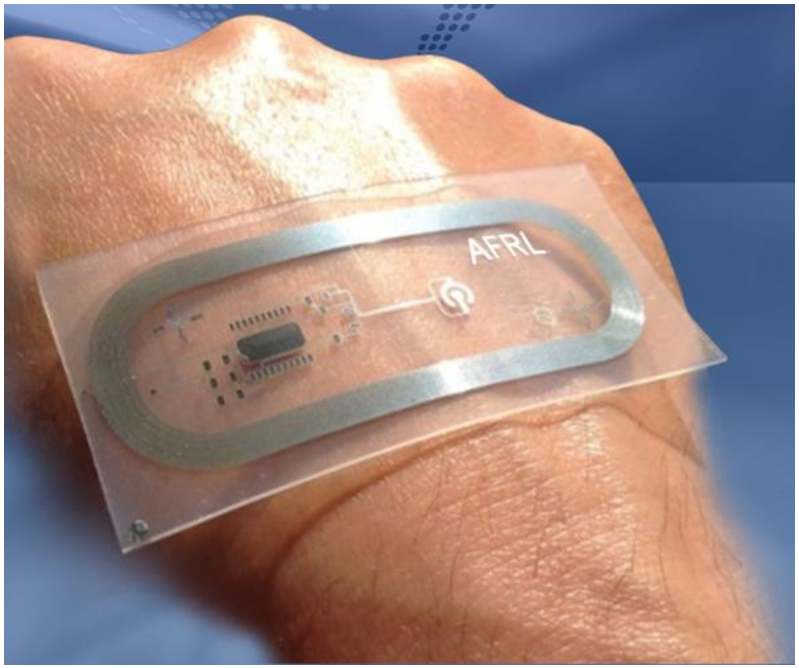
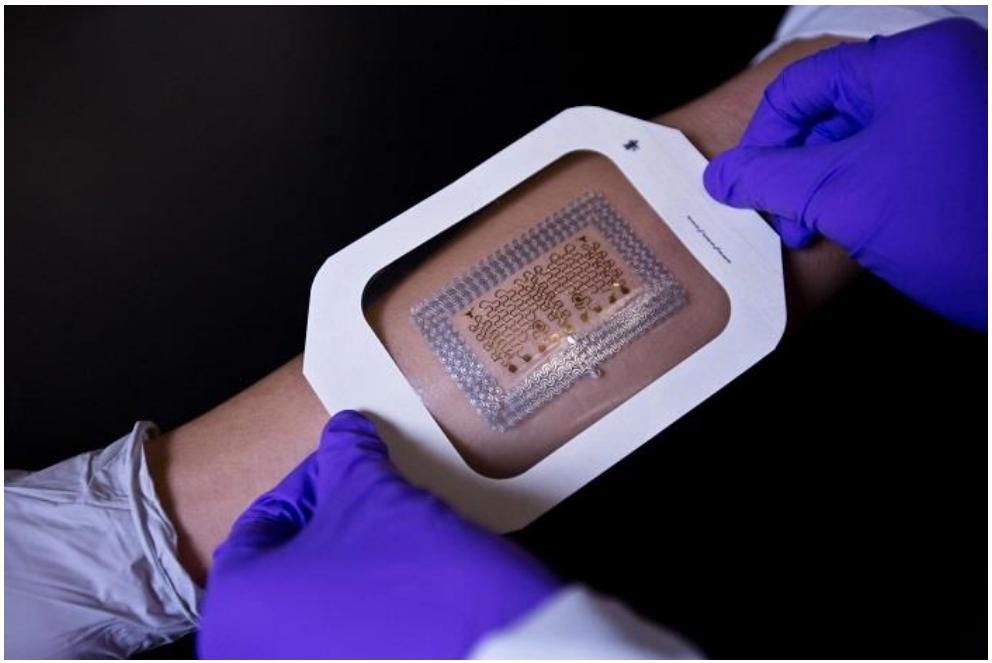
Flexible Hybrid Electronics

Building the future of medicine through the development of FHE-based medical devices that enable:

- The collection of clinical grade health data
- The creation of next-generation medical devices





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THE INTERNET OF THINGS

Time Domain

When we have gone from manual operation in many process to automation we have relied too heavily on the **time domain**…

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Need Domain

Significant waste can be eliminated by operating in a **need** domain

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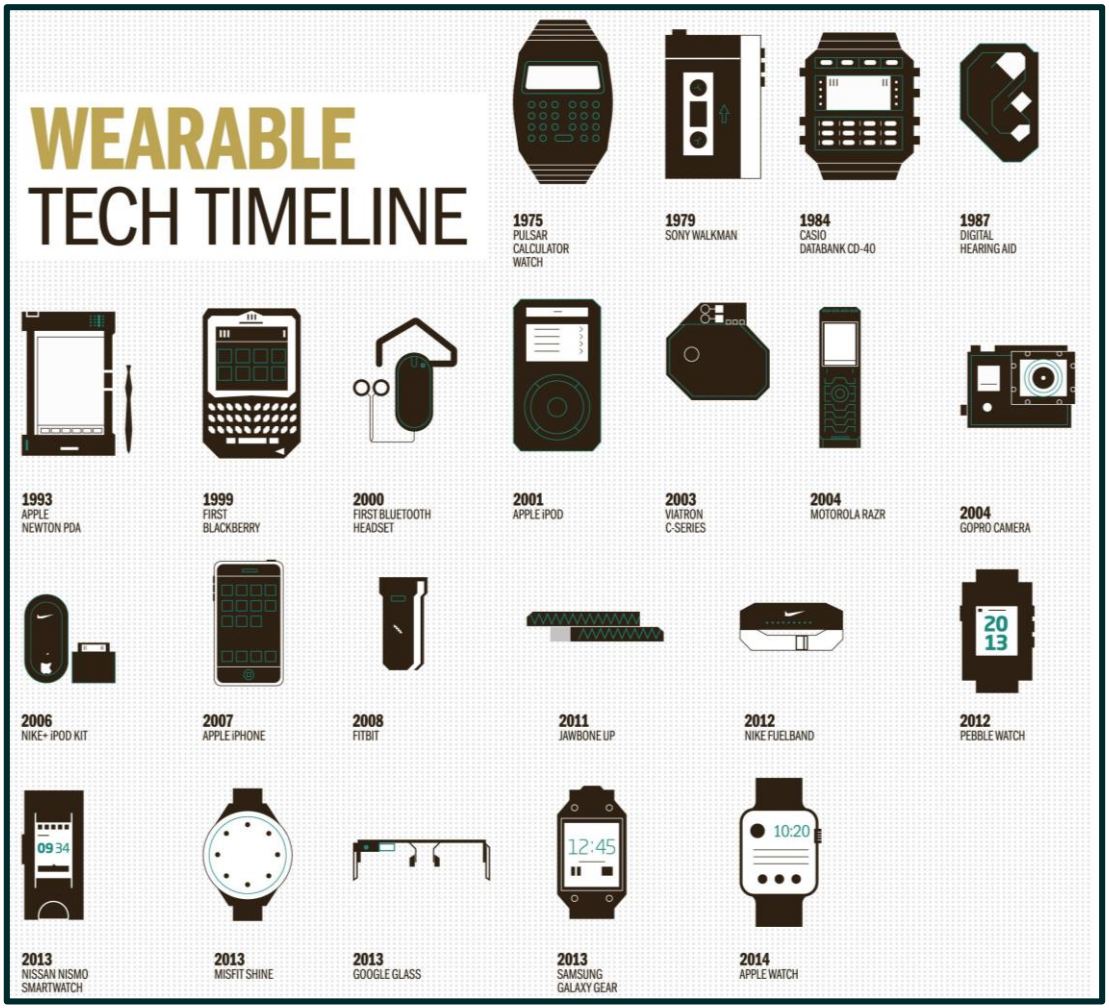
THE INTERNET OF PEOPLE

Digital Wearables



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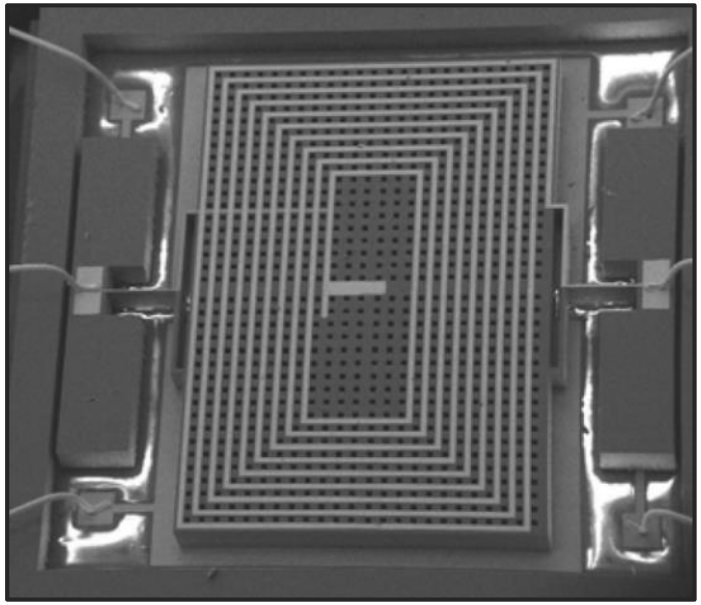
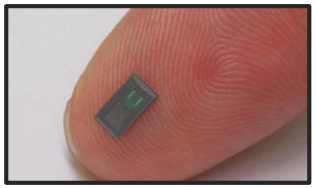
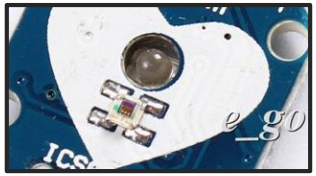
Classic Wearable Sensors

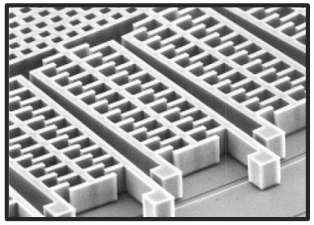
Motion-Tracking Sensors
- Accelerometer
- Gyro
- Magnetometer
- GNSS (GPS, GLONASS, Galileo)

Bodily Function Sensors
- Heart Rate Sensor
- Pulse Oximetry
- Temperature Sensor









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A Shift to More Insightful Data

Imaging Modalities
- CT, X-ray, MRI, Ultrasound, Terahertz

✓ Human Health Monitoring Sensors
- Vital sign monitors, disease state, fatigue, hydration, stress, wound care
- Longer term devices that sense, assess and respond

Implantable devices
- Neural implants
- Pacemakers

✓ Diagnostic systems
- With both on- and in-body possibilities
- Compact & stand alone

Biomarker Examples
- ✓ Neuropeptides (NpY, Orexin A..)
- ✓ Cytokines
- ✓ Catecholamines
- ✓ Corticosteroids
- ✓ PSMA/Antigens
- ✓ Glucono Lactone(glucose oxidase)
- ✓ Saccharide (boronic acid)

	Measurement	Input Needed	Connection	Continuous
Temperature	**Electrical**	**Voltage**	**Skin Contact Electrodes**	**Yes**
Electrocradiogram	**Electrical**	**Passive**	**Adhesive Electrodes**	**Yes**
Photoplethysmograph	**Optical**	**Light**	**Adhesive Sensor**	**Yes**
Electrolytes	**Potentiometry**	**Wicked Sweat/Blood**	**Wick**	**Yes**
Blood Gasses	**Amperometry**	**Capillary Blood**	**Microneedle**	**Yes**
DNA Markers	**DNA**	**Nucleic Acid Amplification/Fluid Sample**	**Swab/Tissue Sample**	**No**
Protien Markers	**Eletrochemical/Optical**	**Swabbed Blood/Sweat/Urine/Sweat**	**Swab**	**Maybe**

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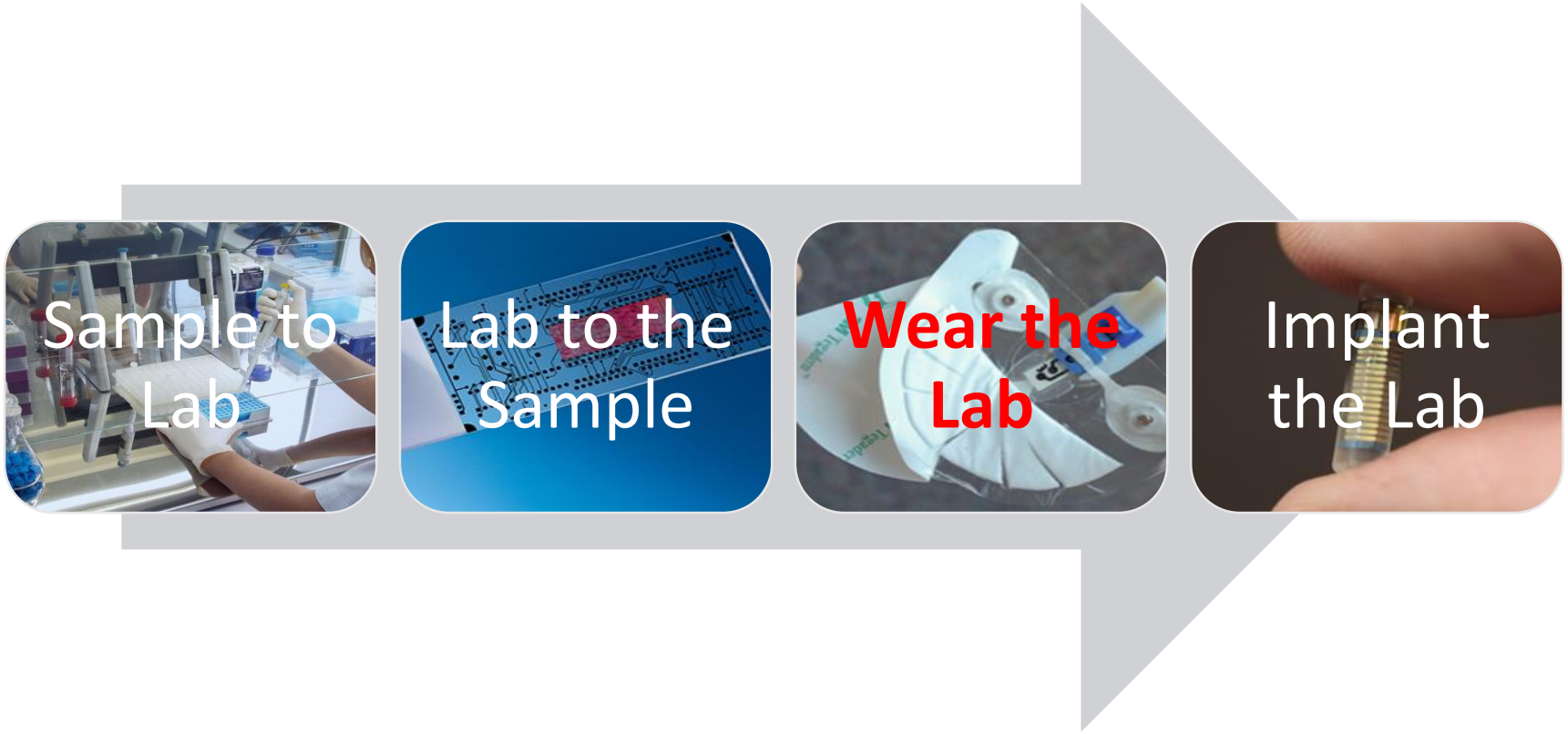
Four Waves of Monitoring People



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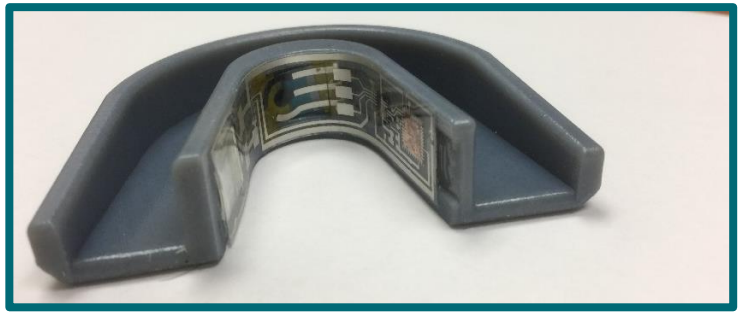
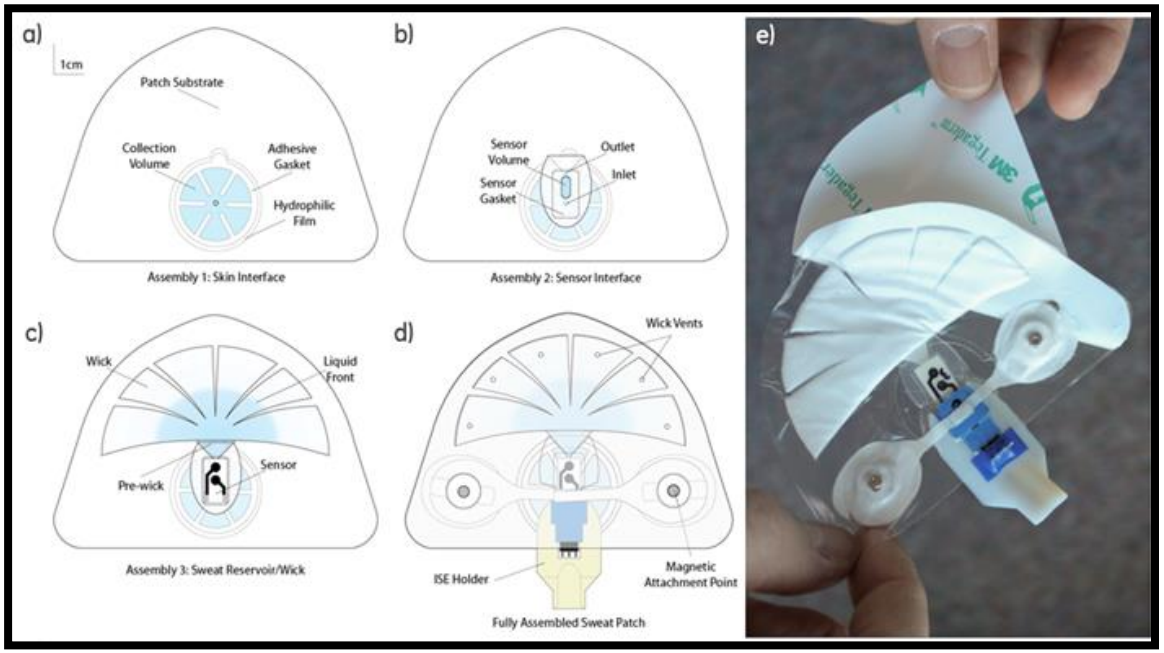
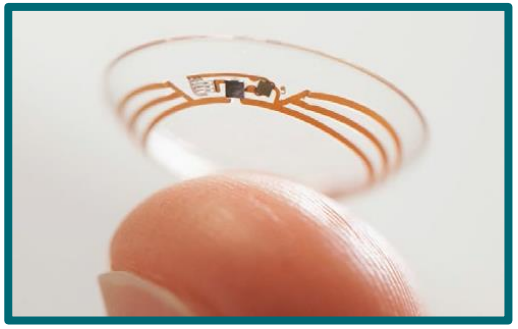
Next Generation Wearables







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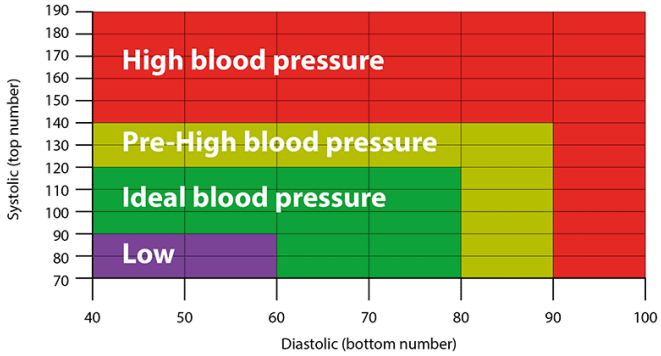
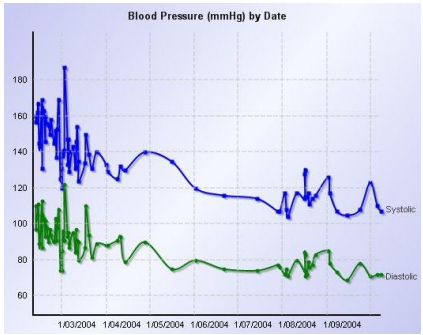
Purpose of Wearables





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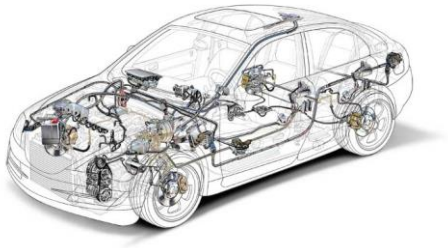
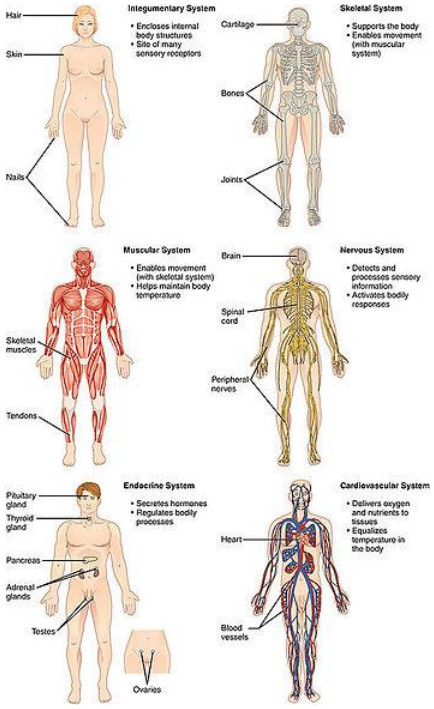
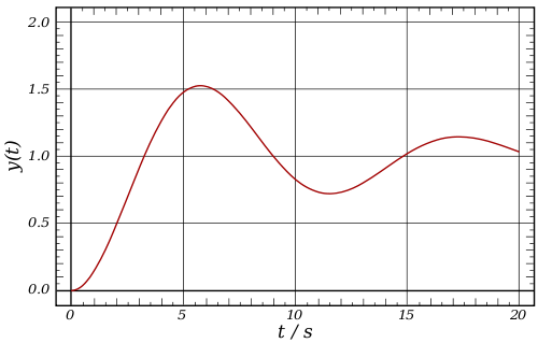
Maintaining People



- ✓ Engine electronics
- ✓ Transmission electronics
- ✓ Chassis electronics
- ✓ Active safety
- ✓ Driver assistance
- ✓ Passenger comfort
- ✓ Entertainment systems
- ✓ Electronic Integrated Cockpit systems



- ✓ Cardiovascular / Circulatory system
- ✓ Digestive system / Excretory system
- ✓ Endocrine system
- ✓ Integumentary system/ Exocrine system
- ✓ Lymphatic system / Immune system
- ✓ Muscular system/Skeletal system
- ✓ Nervous system
- ✓ Renal system / Urinary system
- ✓ Reproductive system
- ✓ Respiratory system



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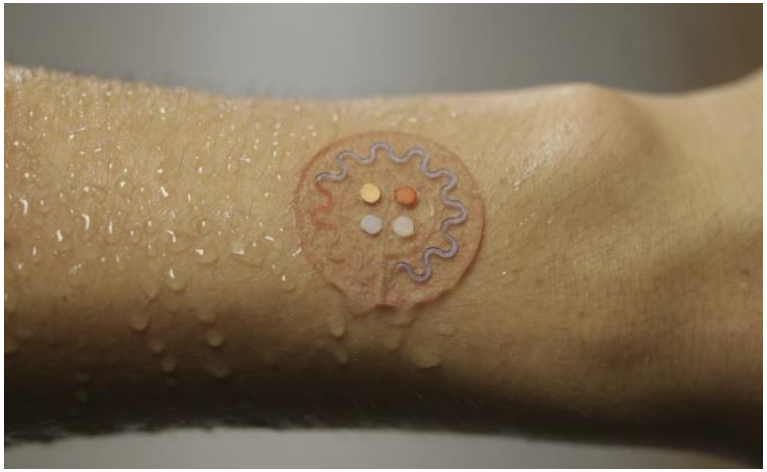
Why FHE For Wearables of the Future?

- ✓**Form Factor**
- ✓Conformability
- ✓Stretchability
- ✓Transparency
- ✓Breathability



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Monitoring Telemedicine

Mercy Virtual

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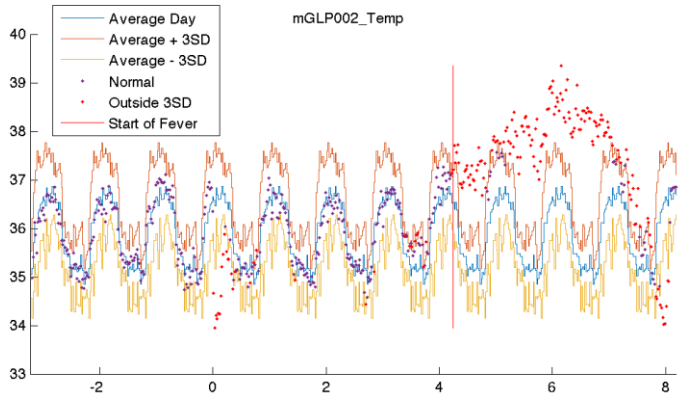
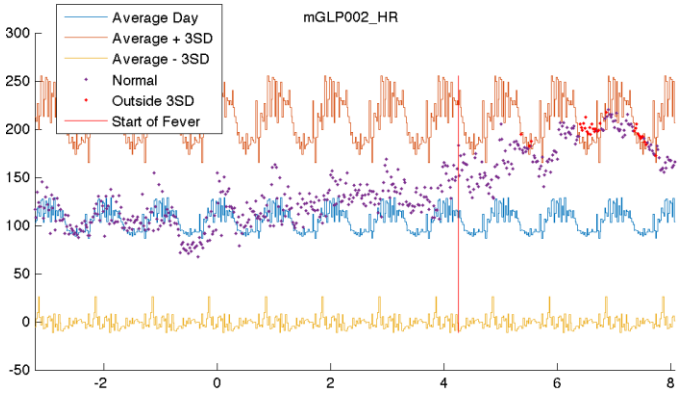
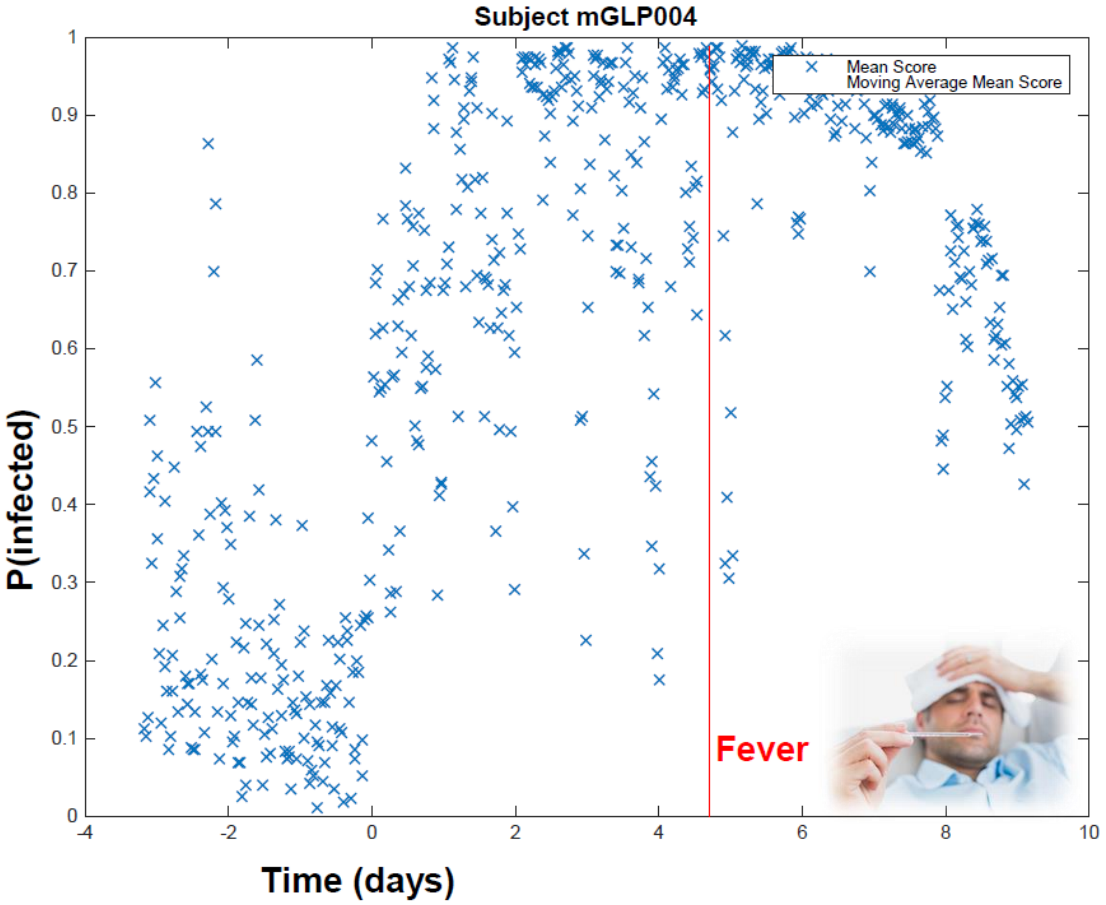
Medical Application







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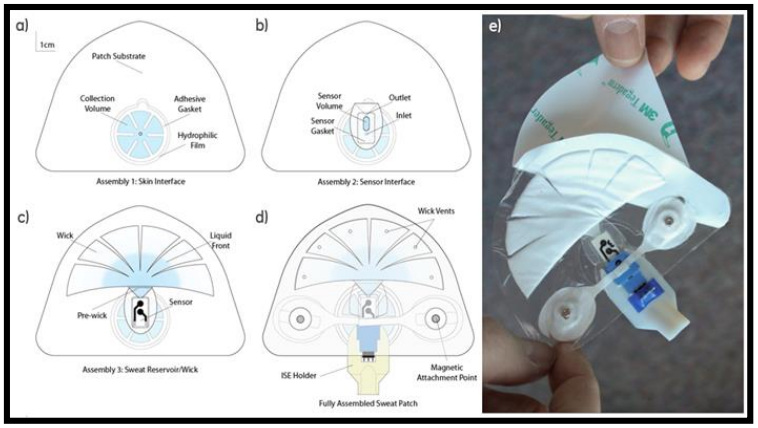
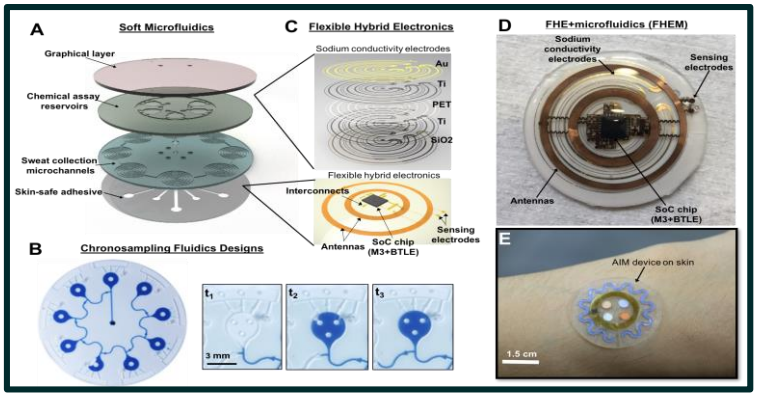
NEXTFLEX DEVELOPMENT PROGRAMS

Hydration & Biomarkers





BINGHAMTON UNIVERSITY
Northwestern University
EPICORE BIOSYSTEMS

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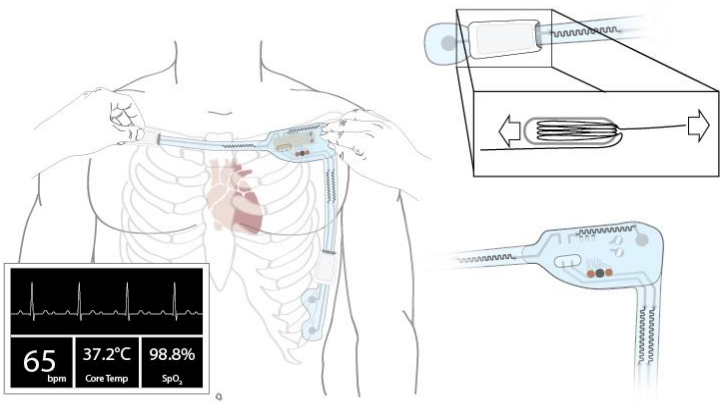
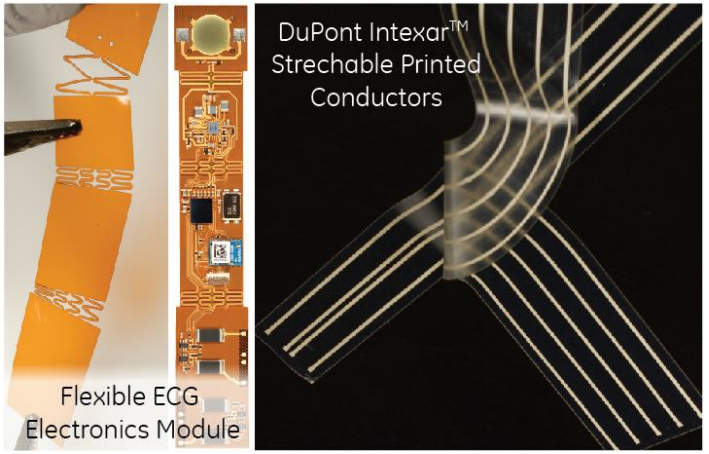
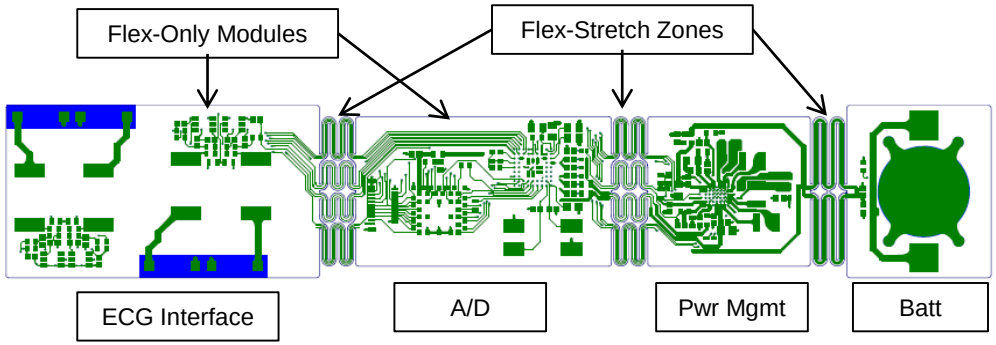
Wireless Disposable ECG







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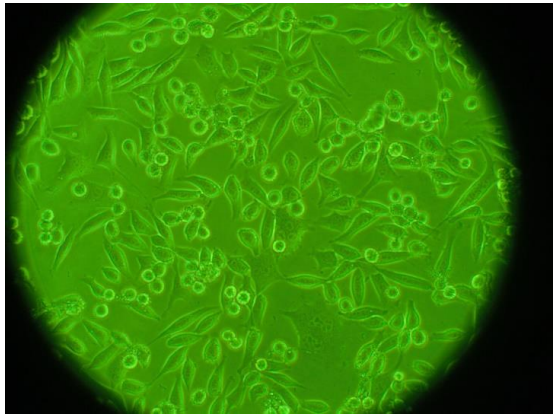
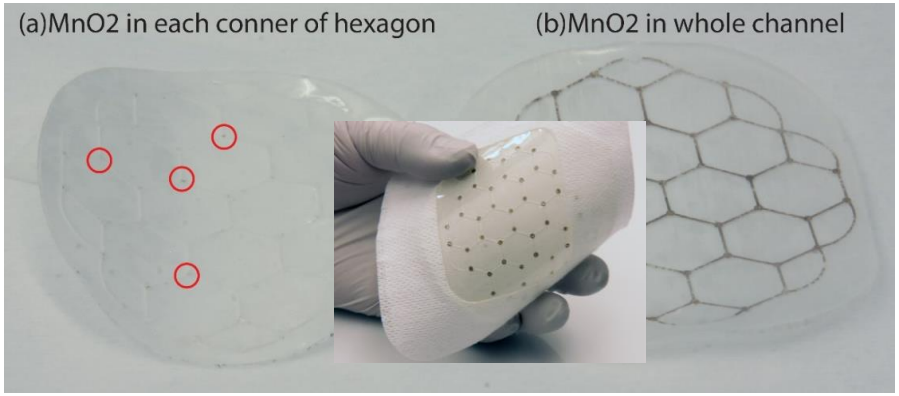
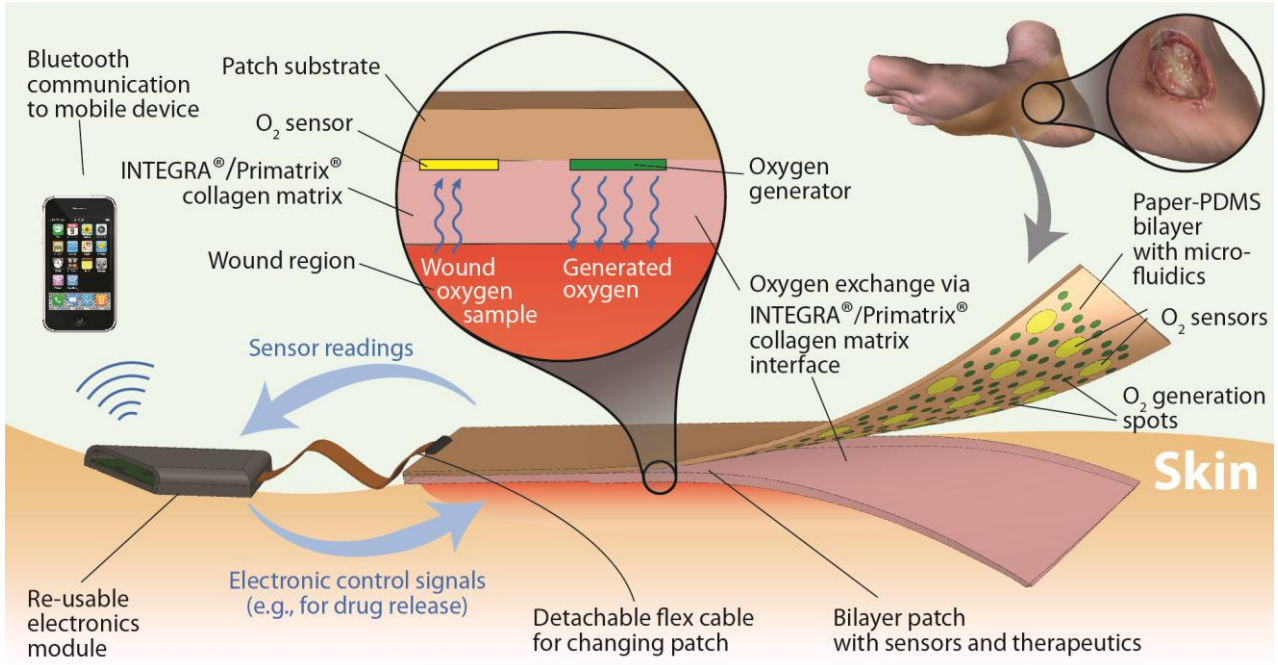
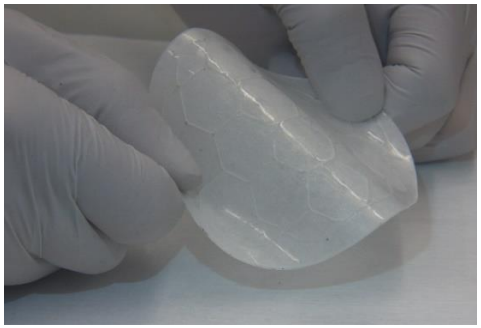
Chronic Wound Smart Badge









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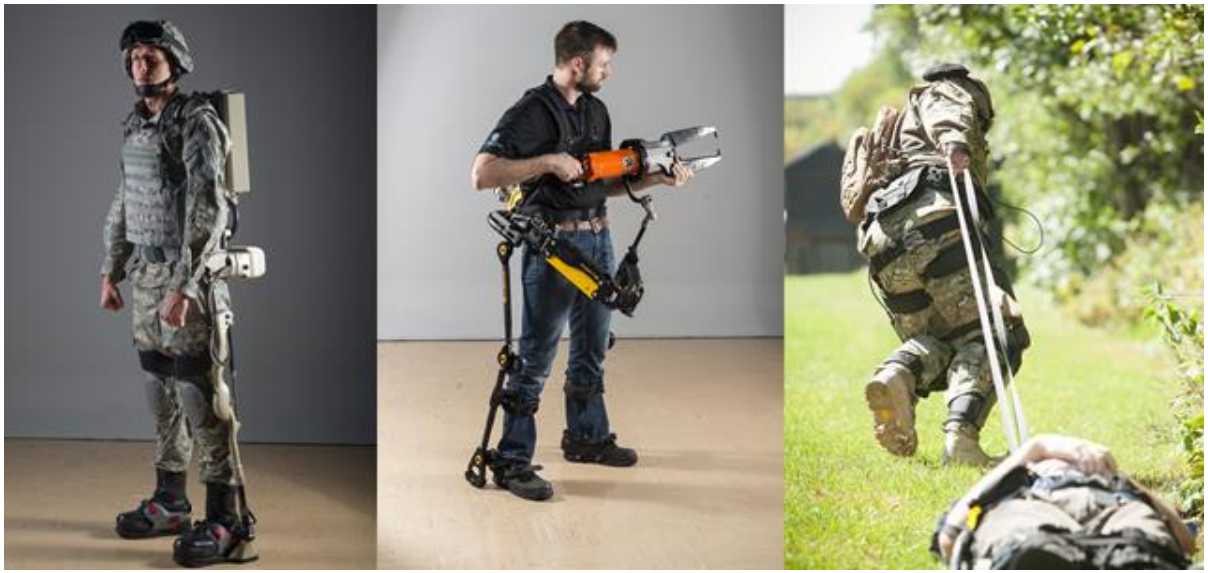
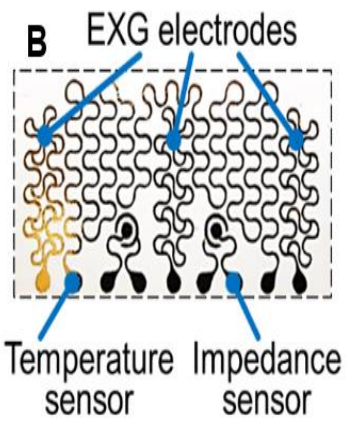
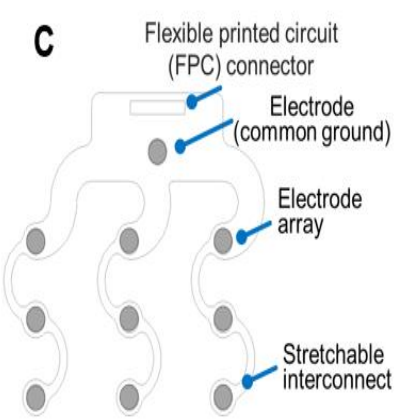
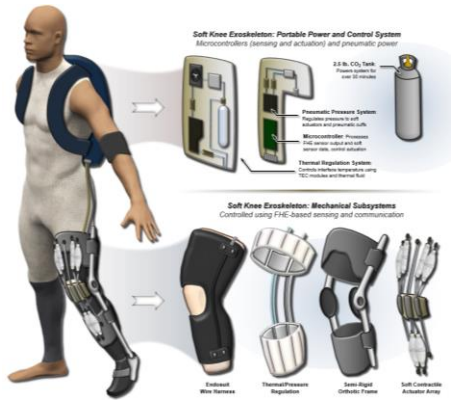
Wearables, EMG, and System Control









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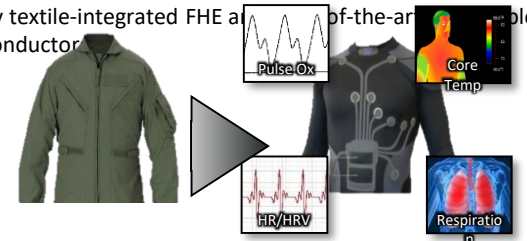
Physio Smart Flight Suit

Concept Overview

Objectives: Integrated compressive undershirt compatible with standard aircrew ensemble to enable collection & transmission of biometric & vital sign data via CSEL. Monitoring by this garment will be non-invasive, enabled by textile-integrated FHE a[illegible]f-the-ar[illegible]le conductor[illegible]

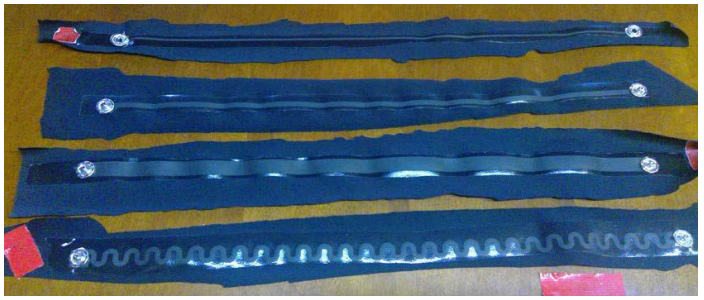


Technology Challenges

- **Challenging Operational Environments**
  - Secure data handling
  - Resilient materials and electronics
- **Flexible Hybrid Electronic (FHE) Materials**
  - Manufacturing ready
  - Reliable, rugged, and comfortable
  - Cost reduction
- **Multiplexed Analytics**
  - Assessment of pilot identity
  - Automated analysis of pilot's state

Program Benefits

- Integration with advanced cockpit automation to enable teaming.
- Supports real-time decision-making → faster/more efficient treatment and biometric validation
- Potential for performance tracking/enhancement benefits to individuals (pilots & trainees)



HUMAN SYSTEMS INTEGRATION
A REVOLUTION IN WEARABLE TECHNOLOGY

AIR FORCE RESEARCH LABORATORY

DUPONT

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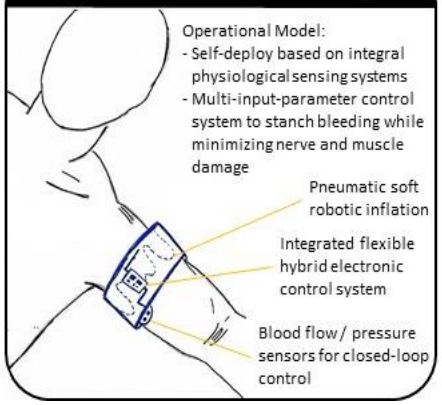
Soft Robotic Tourniquet

Autonomous Soft Robotic Tourniquet

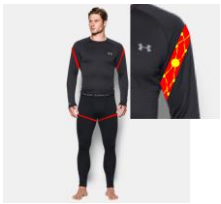


Outcomes:

- Autonomous soft-robotic tourniquet for trauma casualty care and transport
- Path to advanced technology development
- Higher survival, improved quality of life

Innovative Approaches:

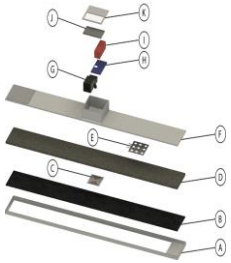
- Soft-robotics with integrated flexible hybrid electronics
- Novel sensor schemes and control systems
- New integration schemes for medical-device relevant materials
- Sensor identification and integration
- Closed-loop control for next-generation care

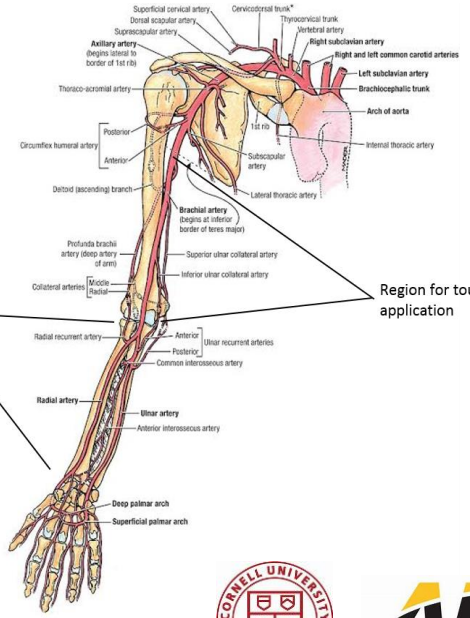


Roman Military Field Tourniquet (ca. 199 BCE)

Modern Military Field Tourniquet

Orthopedic Surgery Tourniquet System





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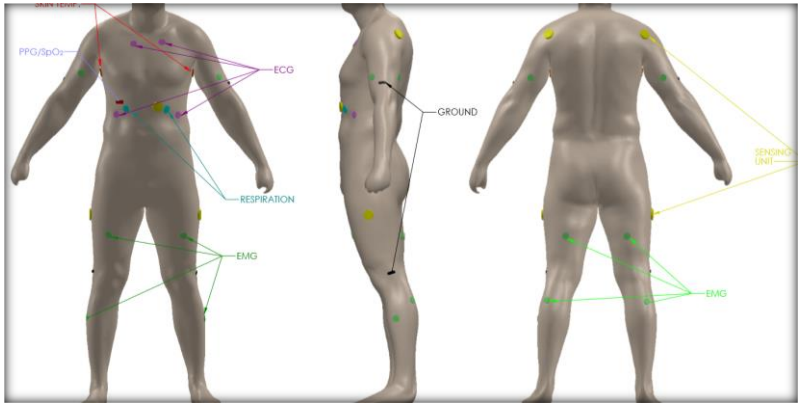
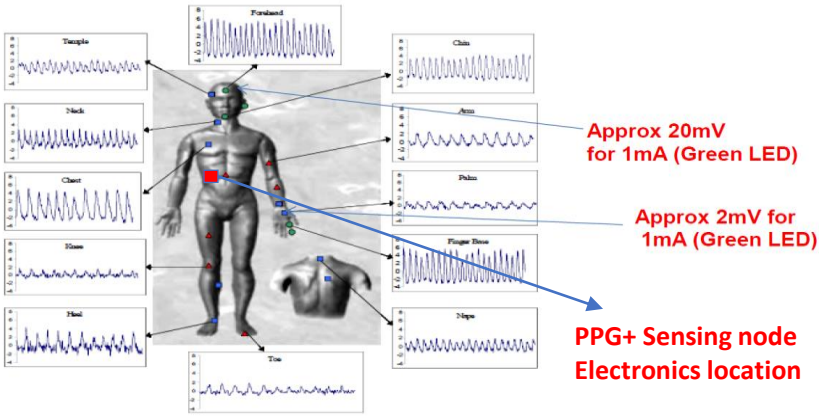
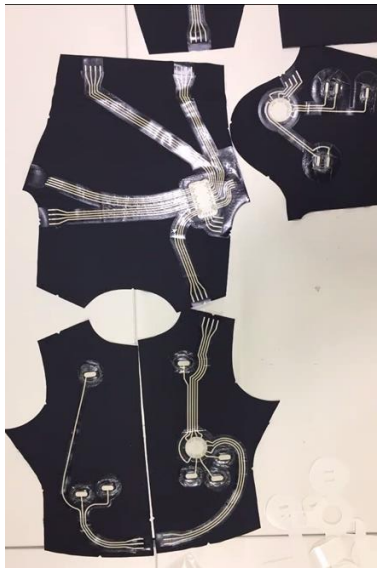
Talos Baselayer







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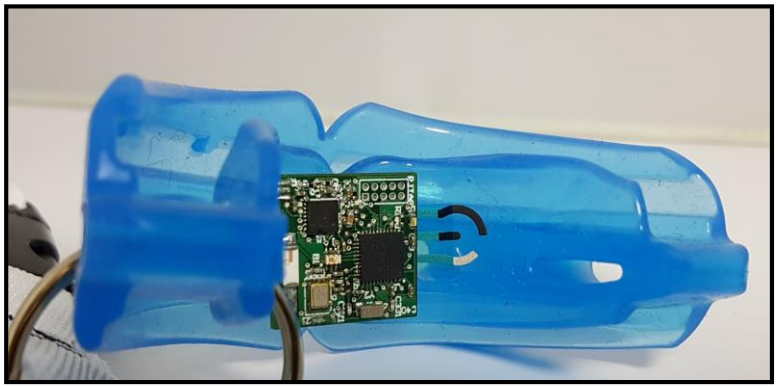
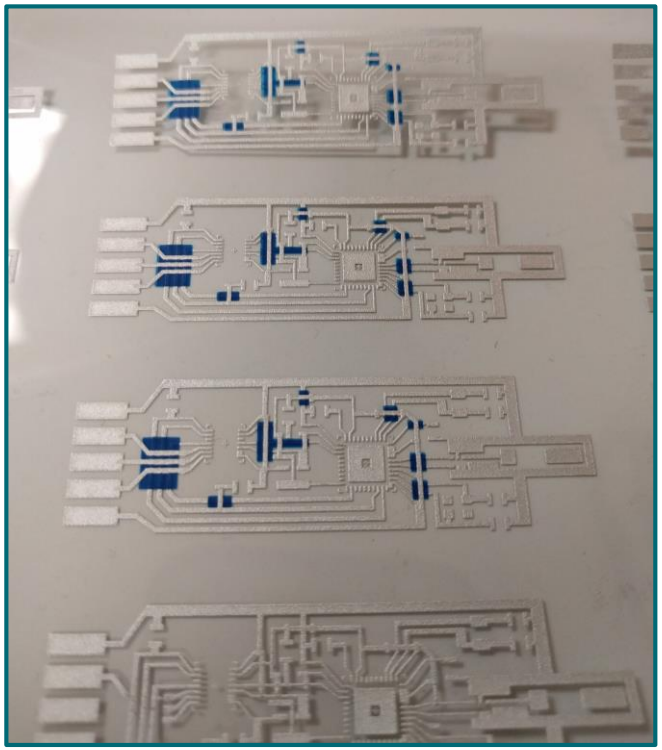
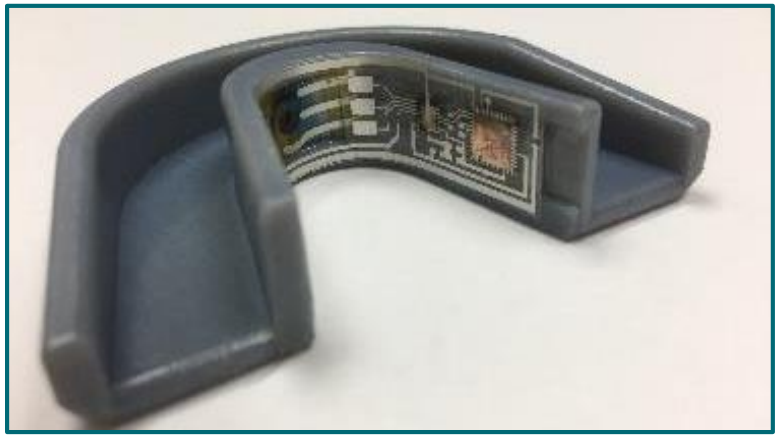
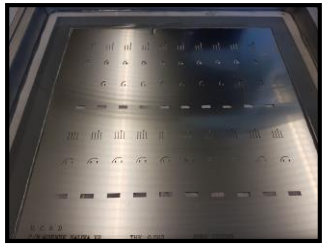
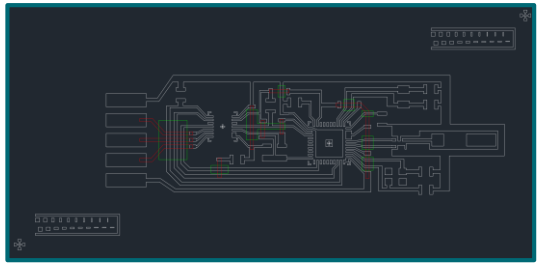
Real Time Oral Biochemistry

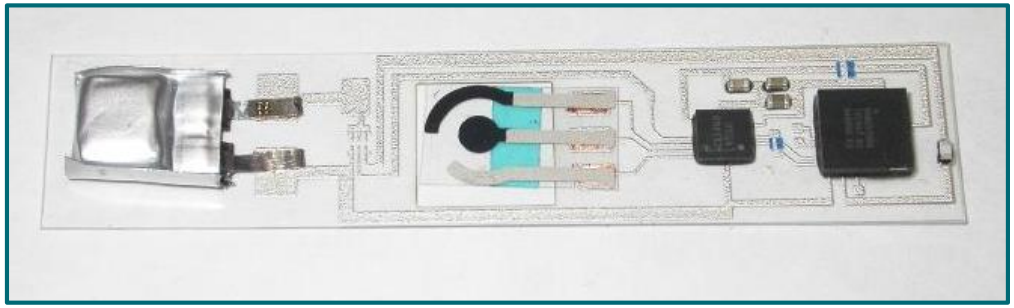












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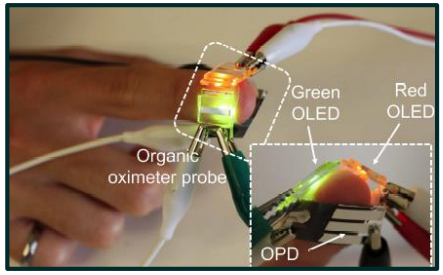
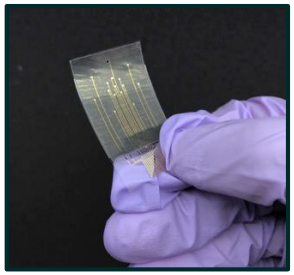
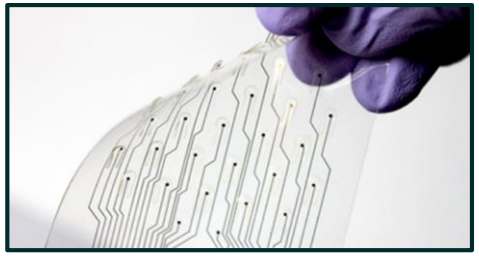
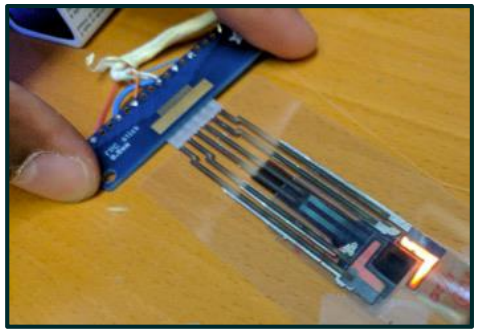
Electro-Stimulation Smart Bandage

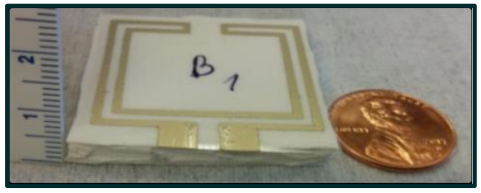


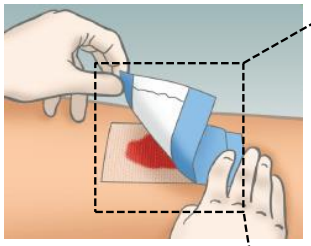


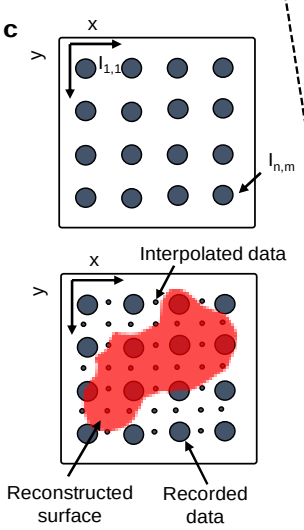
Objective:
Provide local closed-loop control and feedback on the electric stimulation of cutaneous wounds with wireless data transfer capabilities.

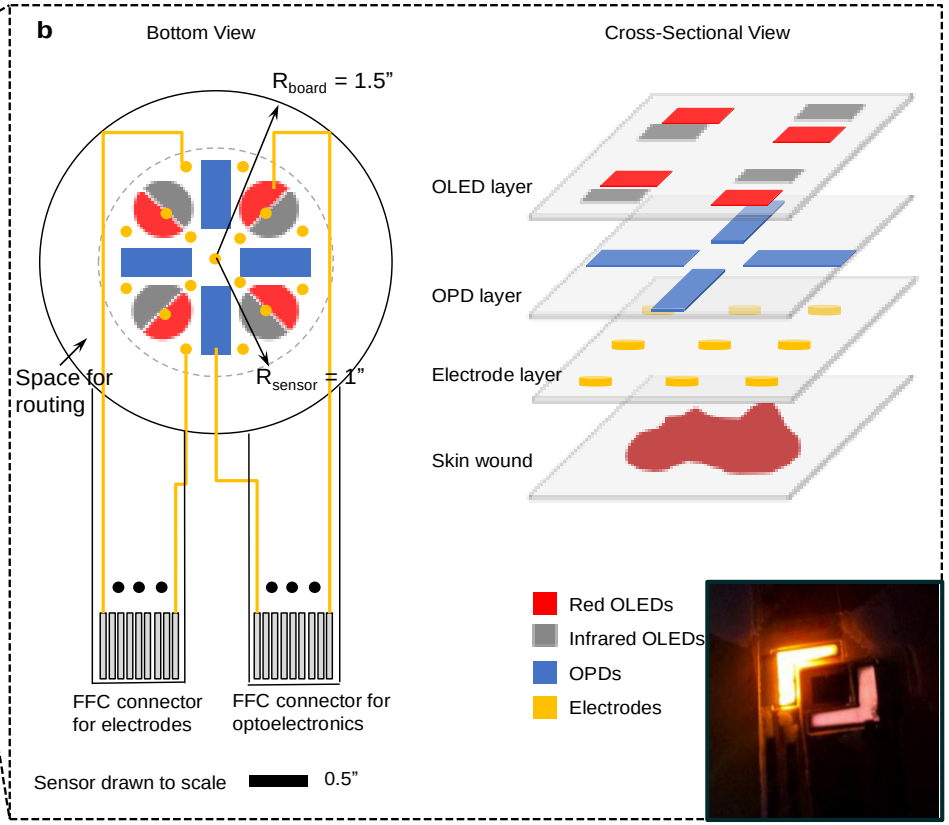












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FUTURE POSSIBILITIES WITH FHE

Wearable Environmental Sensing

- ✓ Nerve Agents
- ✓ Respiratory Agents
- ✓ Toxic Industrial Materials
- ✓ Toxic Industrial Chemicals
- ✓ Anthrax
- ✓ Ebola
- ✓ SARS
- ✓ Genetically Engineered Threats

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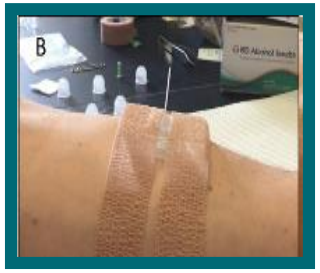
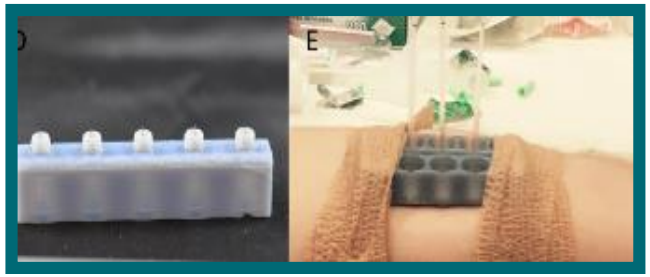
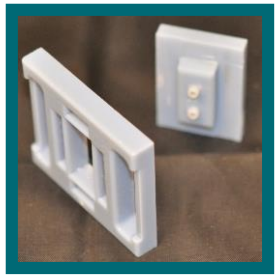
Microneedles: Advancing Form Factors



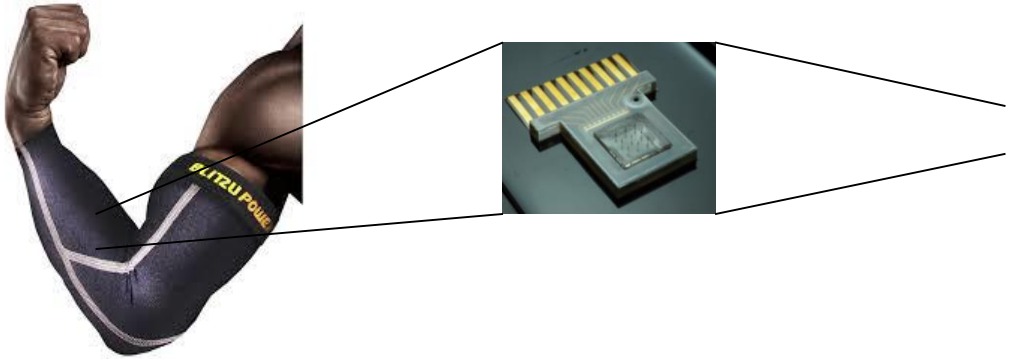
Generation 1:
single needle

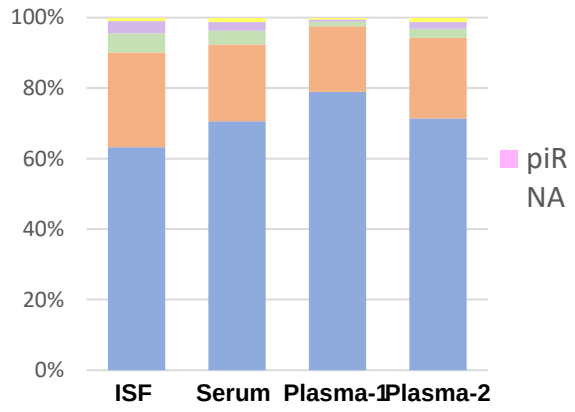


5-20 µl ISF
Humans
40-50 µl ISF Rats



Removable Cartridge
Hands free





Sandia National Laboratories

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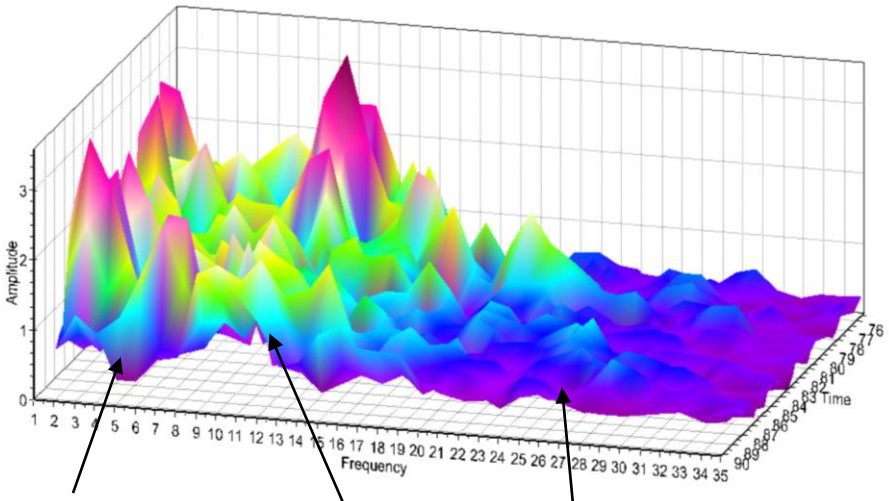
Brain Training with EEG

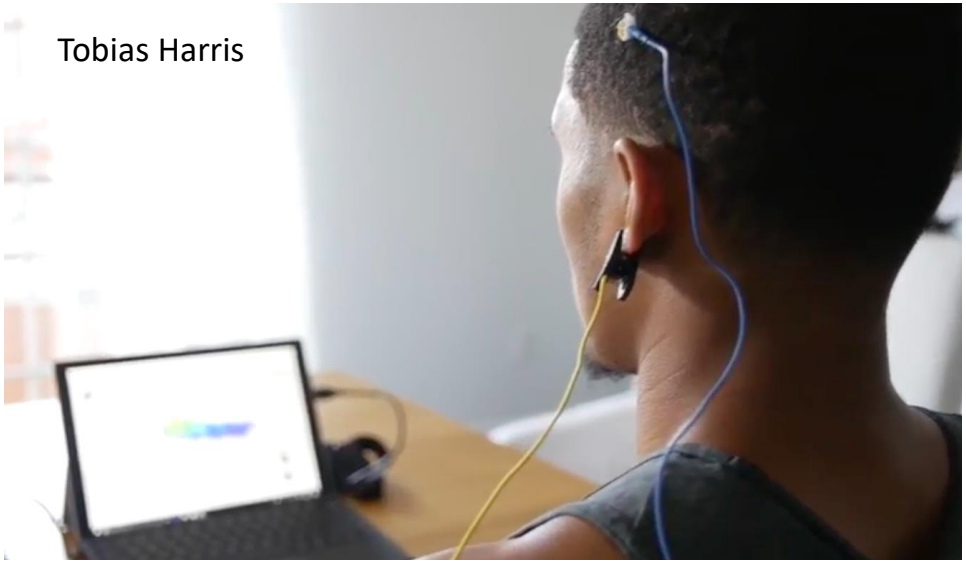


Healthy Delta and Theta

Elevated Alpha and SMR

Minimal High Beta

Tobias Harris



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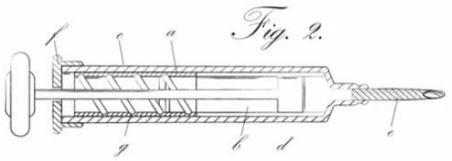
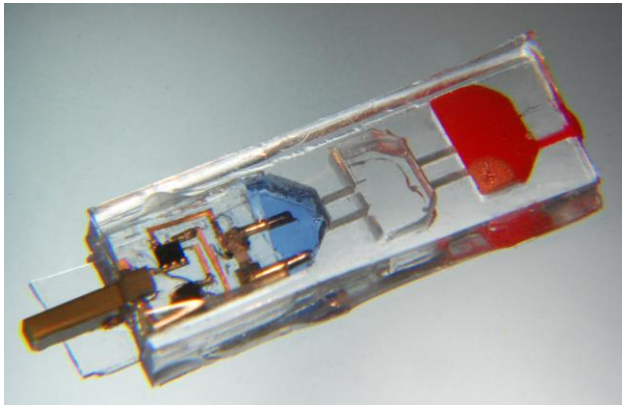
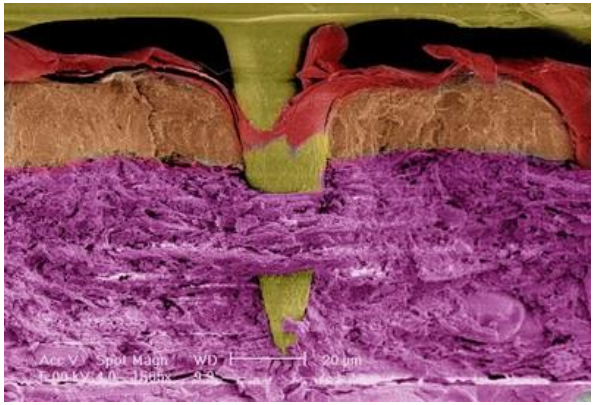
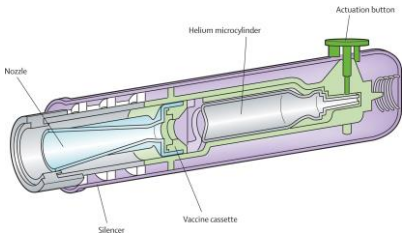
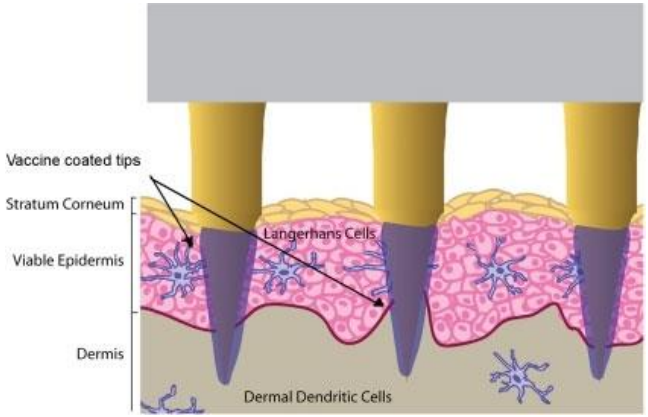
Future of Drug and Vaccine Delivery

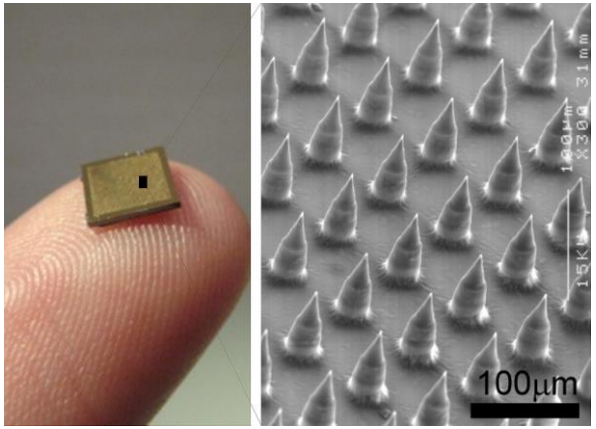












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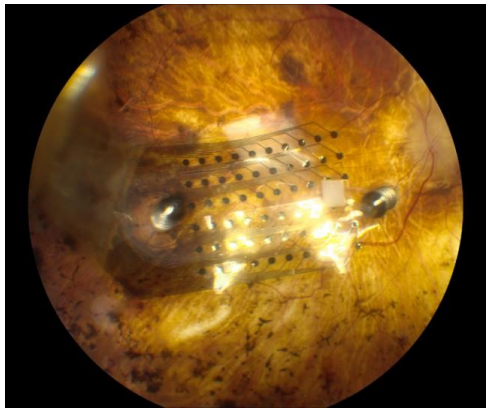
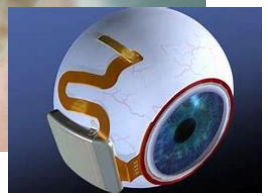
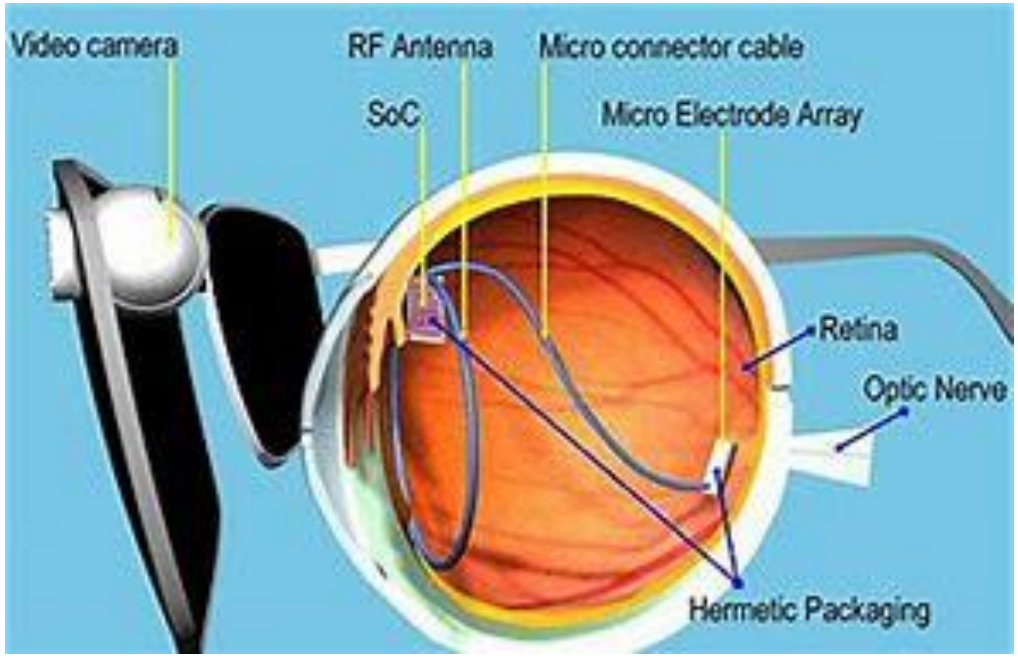
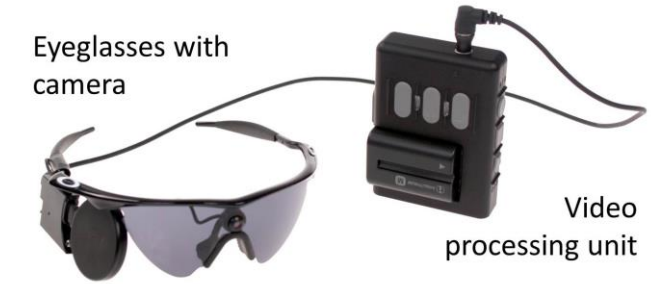
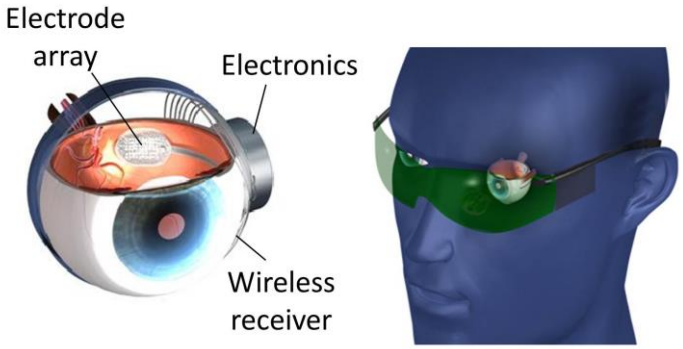
Retinal Protheses











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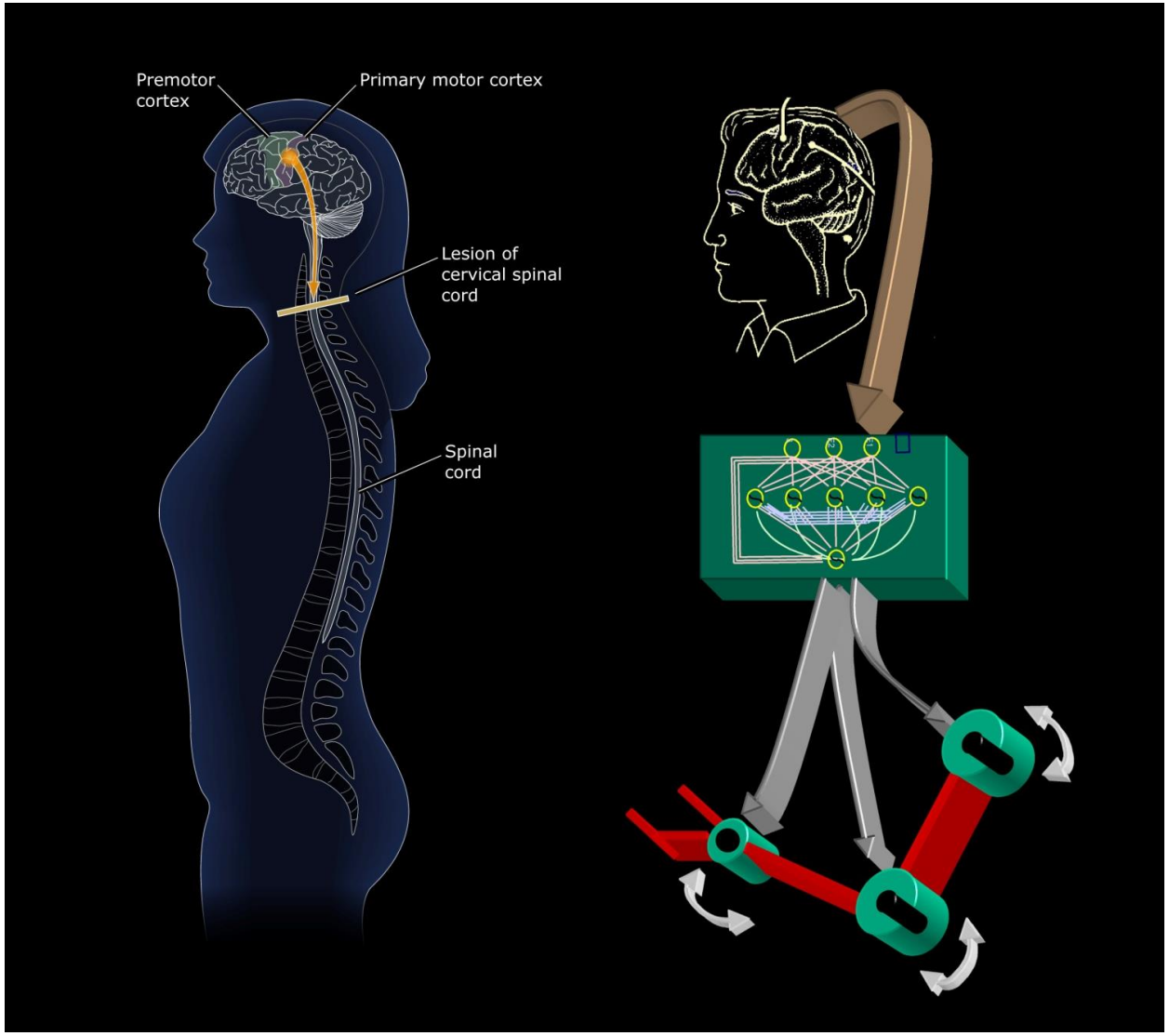
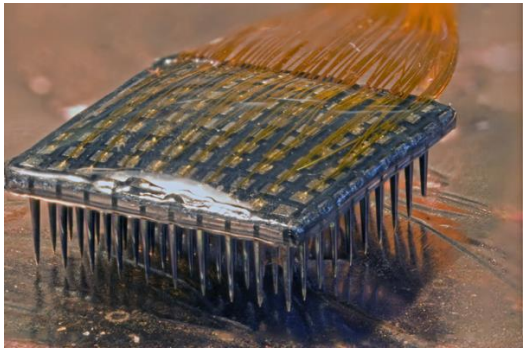
Neural Interfaces





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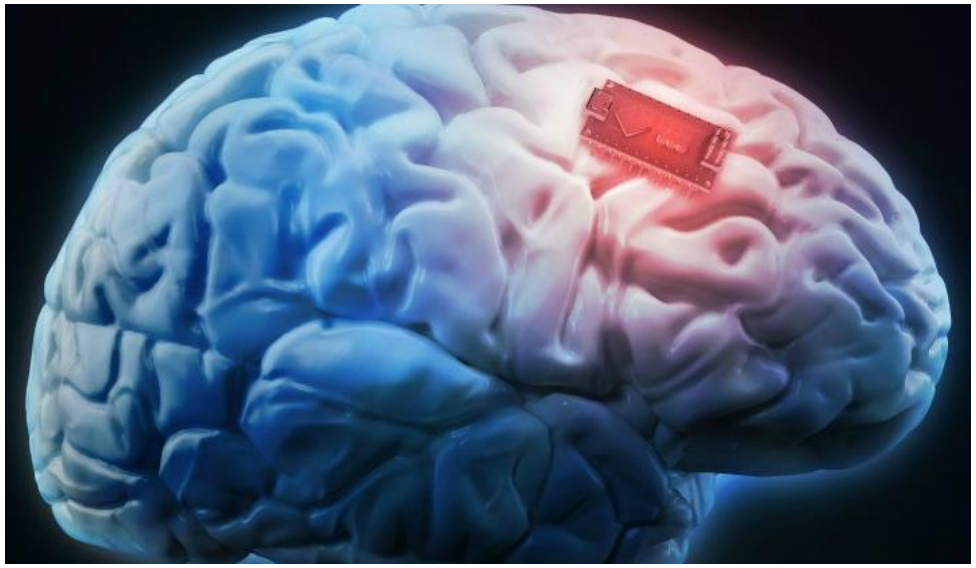
Shaking Hands With Your Thoughts



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Emily McGrath
emcgrath@nextflex.us

Wrap-Up / Next Steps

- **Want to get involved?**
  - ✓ Topic or Speaker ideas
  - ✓ Key Note Presenter
  - ✓ Blogger | Tweeting | Podcast
- **Contact:**

- Ian E. Hoffberg
  ihoffberg@himss.org
- Rod Piechowski
  rpiechowski@himss.org

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