The Medical Electronic Device Realization Center

Student Project Summaries

Charlie Sodini
Evolving Local MedTech Ecosystem
DEFINING THE FUTURE OF MEDICINE AND HEALTH CARE

CRC: MIT Clinical Research Center
HST: Harvard-MIT Health Sciences and Technology
MEDRC: Medical Electronic Device Realization Center
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<tr>
<th>Name</th>
<th>Institution</th>
<th>Project Description</th>
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<tr>
<td>Noopur Raje</td>
<td>MGH Cancer Center</td>
<td>Diagnosing Drug Resistance in Multiple Myeloma for guiding Personalized Treatments</td>
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<tr>
<td>Scott Manalis</td>
<td>MIT</td>
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<td>Michael Westover</td>
<td>MGH Neurology</td>
<td>Big Data and Deep Learning for the Interictal-Ictal-Injury Continuum</td>
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<td>Sam Madden</td>
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<td>Eric Rosenberg</td>
<td>MGH Pathology</td>
<td>Rapid Diagnosis of Ventilator-Associated Pneumonia (VAP) and Bacterial Infection</td>
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<td>Max Shulaker</td>
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<td>through Big-Data Sensing and Analytics of Volatile Organic Compounds</td>
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<td>Sanjat Kanjilal</td>
<td>MGH Medicine</td>
<td>Optimizing Antibiotic Therapy through Machine Learning Models</td>
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<td>David Sontag</td>
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<td>Mangudi Varadarajan, Kartik</td>
<td>MGH Orthopedics</td>
<td>Non-invasive Diagnosis of Joint Replacement Implant Failure via Electrical Impedance Tomography</td>
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<td>John Hart</td>
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Addressing **clinical needs**, by innovating user-centric devices, leveraging the power of microelectronics and information technology in the Boston / Cambridge Ecosystem.

- Analog Devices
- Nihon Kohden
- Novartis
- Philips Research
A Portable Bioimpedance Measurement System for Congestive Heart Failure Management

Maggie Delano (Swarthmore) and Charlie Sodini

- Dialysis Patient Monitoring
  - CHF patients low fluid overload
  - CHF patients low rate of fluid increase
  - Electrode placement and modeling – Ring electrode
Non-invasive Arterial Pressure Waveform Monitoring

Joohyun Seo, Hae-Seung Lee, Charles Sodini
MIT Microsystems Technology Laboratories

Motivation

• Arterial Blood Pressure (ABP) ‘waveform’ contains substantial information about dynamic nature of the arterial system
• Arterial catheterization is highly invasive, preventing routine usage
• Ultrasound to estimate vessel elasticity and the pulsation of the artery

Blood Flow

Elasticity & Area Estimation

Diameter

ABP Waveform

Ultrasound Method (Carotid)
Finger Waveform
The AutoScope: An Automated, Point-of-Care Urinalysis System

Sidney Primas, Charles Sodini
MIT Microsystems Technology Laboratories

Motivation
• >100M microscopic urine tests ordered each year in the USA
• Microscopic urinalysis is costly and complex, and often done in central medical laboratories
• The AutoScope is inexpensive and automated, enabling testing directly at the point-of-care

Results

<table>
<thead>
<tr>
<th>Particle</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Blood Cells</td>
<td>88%</td>
<td>89%</td>
</tr>
<tr>
<td>White Blood Cells</td>
<td>91%</td>
<td>97%</td>
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</tbody>
</table>
Motivation

• The ballistocardiogram (BCG) waveform contains information regarding one’s stroke volume as blood is ejected from the heart
• Cardiac output can be calculated using stroke volume and heart rate
• Currently used invasive methods for measuring cardiac output require arterial catheterization which has increased cost and risk to the patient