<table>
<thead>
<tr>
<th>Page #'s</th>
<th>Title</th>
<th>Name</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-15</td>
<td>Tissue Engineering and Regenerative Medicine</td>
<td>Lon Cook</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>16-24</td>
<td>Drug Delivery Systems and Transitional Energy</td>
<td>Bill Pitt</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>25-31</td>
<td>Unmanned Aerial Vehicles and Geotechnical Earthquake Engineering</td>
<td>Kevin Franke</td>
<td>Civil and Environmental Engineering</td>
</tr>
<tr>
<td>32-38</td>
<td>Earthquake Resistant Buildings</td>
<td>Paul Richards</td>
<td>Civil and Environmental Engineering</td>
</tr>
<tr>
<td>39-43</td>
<td>Ultra-Low-Power Neural Amplifiers</td>
<td>Shiuh-hua Wood Chiang</td>
<td>Electrical and Computer Engineering</td>
</tr>
</tbody>
</table>
Tissue Engineering and Regenerative Medicine

Alonzo D. Cook, PhD
Chemical Engineering Dept.
cook@byu.edu
(801) 422-1611

Areas of Interest:
Biomedical Engineering; Cardiovascular repair; Stem Cells; Neuroscience; Vision; Renal Function; Orthopedics
Cook Lab Projects

- Heart
- Kidney
- Eye
- Nerve
- Blood Vessel
Fresh pig heart

Decellularized pig heart
Decellularized Pig Heart
Heart Project

• Remove cells from pig hearts (decellularization)
• Culture human cells (stem cells, cardiomyocytes)
• Visualize cells in 3D inside heart tissue
• Test recellularized hearts for function (beating, pumping)
• Prevent thrombosis, hemolysis of blood
Kidney Project

- Remove cells from pig kidneys
- Culture human cells
  (stem cells, epithelial cells, endothelial cells, etc.)
- Visualize cells in 3D inside kidney tissue
- Test recellularized kidneys for function
- Prevent thrombosis, hemolysis of blood
Rat retina cells

Day 0

Day 1

Day 2

Day 3

Day 4

Day 5
Eye Project

• Culturing rat cells from isolated retinas
• De-differentiating cells to pluripotency
• Measuring kinetics of cell growth
• Adding differentiation factors
• Integrating photoreceptor cells into blind animals to restore vision
SEM of Sciatic nerve

SEM of Decellularized sciatic nerve

Histology of Sciatic Nerve

Electrophysiology of Sciatic Nerve
Nerve Project

- In situ decellularization of sciatic nerve in rats
- Crush injury of nerve
- Chemical injury of nerve
- Combination of crush and chemical injury
- Measurement of loss of action potential
- Addition of nerve growth factor (NGF)
- Analysis of rate of nerve regeneration
Cells encapsulated in alginate hydrogel
Blood Vessel Project

- Printing cells in alginate gels
- Culturing 3D blood vessels
- Crosslinking gels in the presence of cells
- Modifying gels for covalent crosslinking
Drug Delivery Systems and Transitional Energy

Bill Pitt
Chemical Engineering
pitt@byu.edu
(801) 422-2589

Areas of Interest:
Cell Delivery systems, Transitional Energy, Overcoming Multi-drug resistance of cells, Transport of small molecules in contact lenses
Bill Pitt
Chemical Engineering
801-422-2589; pitt@byu.edu

Research area: Drug Delivery
I can deliver stuff to the cell cytosol.
I am looking for collaborative applications of this technology.
We can deliver drugs to cell cytosol

Delivery of the fluorescent molecule calcein using folated eLiposomes and 20 kHz ultrasound at 1 W/cm² for 2 seconds.

Folate, US, and emulsions are required for internal delivery.

Javadi et al., J. Controlled Release 2013
We can delivery plasmids

Confocal image of HeLa cells exposed for 2 hours to ultra eLiposomes containing plasmid, followed by application of 20-kHz ultrasound at 1W/cm² for 2 seconds. (A) eLiposomes were not folated. (B) eLiposomes contained folate in their phospholipid membrane. (C) Folate receptors were already blocked with extra folate before adding the eLiposomes. Pictures were taken 48 hr after applying the ultrasound.
Overcoming Multi-drug Resistance of Cells

We are looking for collaborators who have resistant and sensitive cell lines.
Overcoming Multi-drug Resistance of Cells

We are also looking for collaborators who have antibodies to proteins expressed uniquely on cancer cell surfaces.

Contact: Bill Pitt
pitt@byu.edu
Transitional Energy Research

• Several faculty from Chemical Engineering are starting a collaboration on transitional energy research (transition from fossil fuels to energy of the future).

• We are looking across campus for collaborators with similar interest and experience.
Transitional Energy Research

- **Renewable energy**
  - Biomass, wind, wave, water, solar, etc.

- **Energy Storage**
  - Demand-response technologies, stand-alone energy storage (batteries, etc.)

- **Traditional energy systems**
  - Coal, natural gas, nuclear, combined cycle, single cycle

- **Transportation systems**
  - Electric vehicles, hybrid, clean combustion, etc.
Transitional Energy Research

- Contact (x2-2586)
  - Larry Baxter
  - Tom Fletcher
  - John Harb
  - John Hedengren
  - David Lignell
  - Matt Memmott
  - Bill Pitt
Unmanned Aerial Vehicles and Geotechnical Earthquake Engineering

Kevin Franke
Civil and Environmental Engineering
kevin_franke@byu.edu
(801) 422-1349

Areas of Interest:
Geotechnical Earthquake Engineering: Liquefaction and its effects, Probabilistic (i.e., reliability) analysis methods, Single- and Multi-hazard analysis, Post-earthquake reconnaissance and case histories, Empirical prediction model development; Unmanned Aerial Vehicles (UAVs or drones): High-resolution remote sensing with computer vision and LiDAR, Change detection, Development and use of digital elevation and terrain models, Infrastructure monitoring
Kevin Franke, Ph.D., P.E.
Assistant Professor
Civil and Environmental Engineering
Kevin_Franke@byu.edu
801-422-1349
What are my research interests?

• **Geotechnical Earthquake Engineering**
  • Liquefaction and its effects
  • Probabilistic (i.e., reliability) analysis methods
  • Single- and Multi-hazard analysis
  • Post-earthquake reconnaissance and case histories
  • Empirical prediction model development

• **Unmanned Aerial Vehicles (UAVs or drones)**
  • High-resolution remote sensing with computer vision and LiDAR
  • Change detection
  • Development and use of digital elevation and terrain models
  • Infrastructure monitoring
Current Fleet of UAVs
Example 3D Point Cloud Models
Seeking Collaborations In...

- New UAV applications and sensors
  - Water resources
  - Archeology and cultural resources
  - Biology and wildlife management
  - Earth sciences (glaciers, icebergs, volcanoes, faults, etc)
- Earthquake Engineering
  - Social impacts of earthquakes, particularly from liquefaction damage
  - Multi-hazard assessment of critical infrastructure
  - New advances in applied mathematics and statistics that could improve current design/research methods
  - Numerical modeling (FEM, IGA, DEM)
Kevin Franke, Ph.D., P.E.
Assistant Professor
Civil and Environmental Engineering
Kevin_Franke@byu.edu
801-422-1349
Earthquake Resistant Buildings

Paul Richards
Civil and Environmental Engineering
prichards@et.byu.edu
(801) 422-6333

Areas of Interest:
Structural Engineering; Materials Engineering; Dissipation of Energy; Dynamic Analysis; Blended Learning in Higher Education (Effective on-line course materials (videos), Meaningful automated feedback, Implementable solutions); Trying to get Research Initiation Grant Engineering Education (RIGEE)
Paul Richards
Earthquake Resistant Buildings

Civil and Environmental Engineering
Dissipate Energy Through Damage

Structural “Fuse”

- Hard to replace a building
- Easy to replace a car
High Performance Systems
Too Expensive
Discovering Economical Alternatives

• Steel frames that can undergo large deformations without yielding
• Steel frames with increased “self-centering” capabilities
• Use of new materials to dissipate energy without structural damage
• Increasing inherent damping
Tools

• Dynamic analysis
  – Open-source program (OpenSees)
  – Tool Command Language (tcl)
  – Genetic Optimization

• Component Level Experimental Testing
Other Research Interests

• Blended Learning in Higher Education
  – Effective on-line course materials (videos)
  – Meaningful automated feedback
  – Implementable solutions
Ultra-Low-Power Neural Amplifiers

Shiuh-hua Wood Chiang
Electrical and Computer Engineering
wochiang@byu.edu
(801) 422-6749

Areas of Interest:
Implantable Neural-Recording Devices; Conventional Neural Amplifier; Noise-Canceling Neural Amplifier; Ultra-low-power designs for RF/analog/mixed-signal integrated circuits; ultra-low-power analog front-end circuits, energy-efficient data converters, and novel signal-acquisition and conditioning circuits for biomedical devices and communication systems
Ultra-Low-Power Neural Amplifiers

Shiuh-hua Wood Chiang

Assistant Professor
Department of Electrical and Computer Engineering
Implantable Neural-Recording Devices

- Minimally invasive implantable devices to observe brain activity
- Applications: diagnosis, treatment, brain-machine interfaces

[Rabaey JSSC 2012]
Conventional Neural Amplifier

- Neural amplifier needs to sense µV signals, reject large DC offsets
- Transistors biased in weak inversion to maximize current efficiency

[Harrison JSSC 2003]
Noise-Canceling Neural Amplifier

- Signals at X, Y have opposite polarities, noise the same polarities
- Noise from $M_{2,3}$ is reduced by a factor of $\frac{C_{in}}{C_f}=100$