A Novel Framework for Pain Management & Control
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Key Enabling Technologies - Medical Informatics Research
Embedded Sensors
-Abstraction of Receptors (Pain, Touch, Temperature, ...)
-Layered Architecture (Compute, Communicate, Actuate)
-Energy levels
Wireless Sensor Networks
-Modeling and Simulation of Signaling Pathways
-Communications Protocols
-State Machines & Bayesian Modeling
Wireless Networks
-Communications Protocols
-Multiple Access channels
-Transport capacity

Real-Time Pain Management System
-Layered Architecture
-Platform Independence
-Sensor Network Analysis & Control
-Provisioning
-Activation & Removal of Control Signals

Service Creation System
-Logic, Decision Graphs and Controls
-Control Signals:
-Criteria for Control Activation & Removal

What about Industry?
- Industry has history of
  - forging new research and technology directions and
  - adapting and productizing technology which has demonstrated promise
- Need to strengthen the joint academia/industry research collaborations: joint projects / early stages
- Technology transfer
  - Establish path for tech transfer from academic research to industry
  - Joint projects, faculty, students (academe ----> industry)
- Success Stories: Networking, Parallel and Scalable Computing,
- Industry is interested in Pain Management Technology

Background: The Pain Signaling Pathways
- Sensory Receptors Planted Throughout Our Bodies (Pain/Visc/Temp/Vib/Mac Nerves)
- Receptors Stimulated by Damage Tissues - Tearing, Fracturing, Burning
- Receptors interconnected via network of nerves that run to Control Nervous System

Pain Management & Control: End-to-End Communications Infrastructure

Background: Temporary Relief from Pain
Type 1 Relief: Combination of Off Label medications (Non-invasive Procedures)
-Sleeping Agents
-Opioids
-Anticonvulsant
Type 2 Relief: Block Joints (Invasive Procedures)
Assume Facet Joints are Source of Spinal related Pain
1. Inject Joints with anesthetic + "Steroids"
2. Burns the "Medial" Dorsal Nerve Endings (Receptors)
3. Causes Interrupt of Pain Signal Flow
4. Temporary Relief of Pain
5. When Receptors re-grow after X months → Pain Resumes

Wireless Sensor Network

Patient

Pain Management System

Wireless Network

Distributed Platform

Snapsots/Reports

(Heterogeneous Resources)

Data Collector

Analysis

WSN

Controls

Service Creation & Model

Override Controls

ASE Discretes

Wireless Sensor Logic

Pain Management System

Query/Manual Ctrl

Dendritic Spinal System

Central Nervous System

Muscle

Skin Receptor Axon

Penetration Receptor Spasm Receptor

Muscle

Receptor Axon

Receptor Axon

Dorsal Nerve Root

Spinothalamic Tract

Internuron