

Junior/Senior Engineering Clinic Projects

Sachin Shetty

Assistant Professor

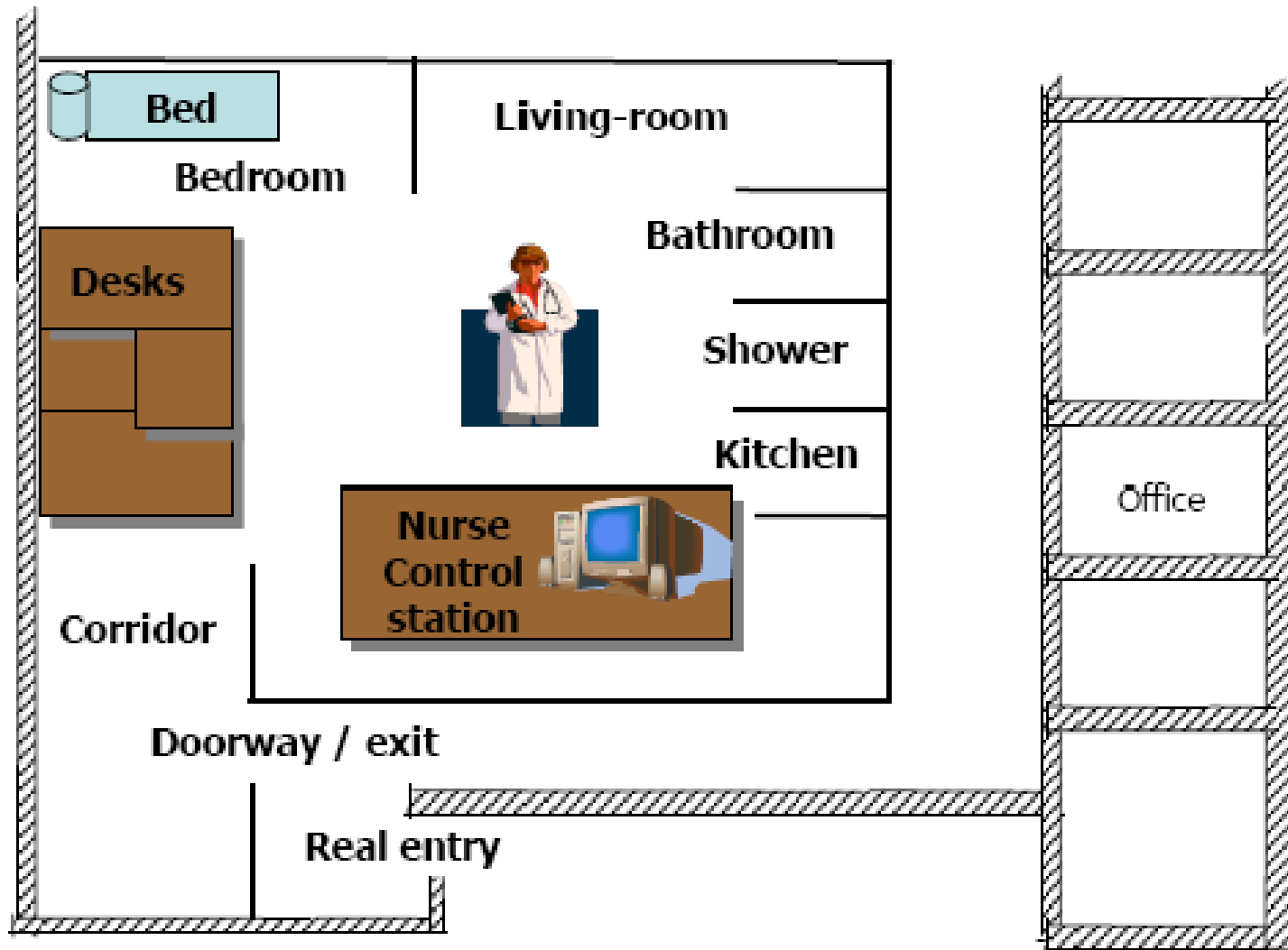
Department of Electrical and Computer Engineering

Rowan University

Project 1 - Wireless Sensor Network for Health Monitoring

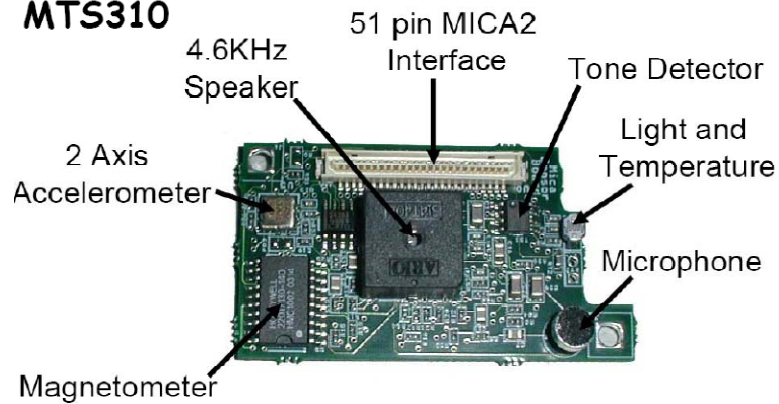
- Overview
 - System architecture for smart healthcare based on an Wireless Sensor Network (WSN).
 - Provides continuous remote health monitoring of patients
 - Environmental sensors evaluate the health of spaces and the people who inhabit them.
 - Authorized care providers may monitor residents' health and life habits and watch for chronic pathologies.

Layout of experimental smart home



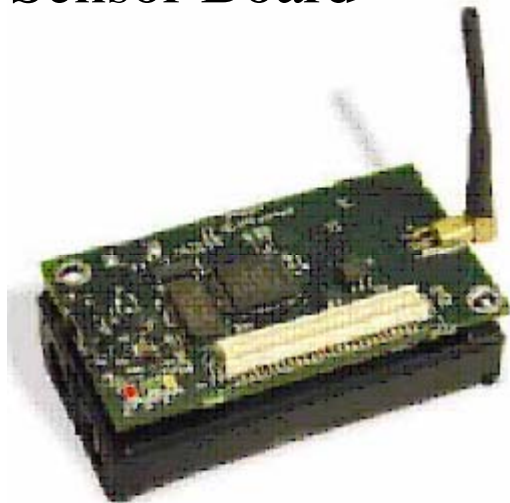
Wireless Sensor Network Hardware

Crossbow
MTS310

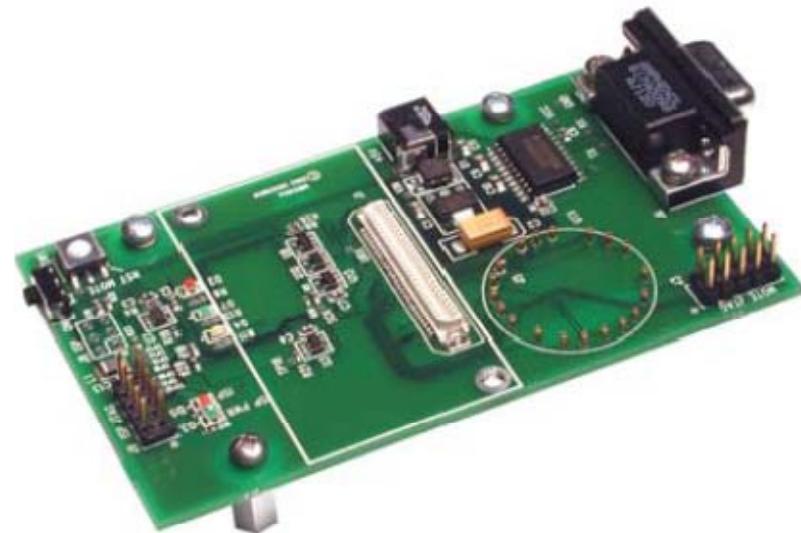


Sensor Board

- 7 Multi-Sensor Boards
- 7 Processor/Radio (Motes)
- 1 Basestation

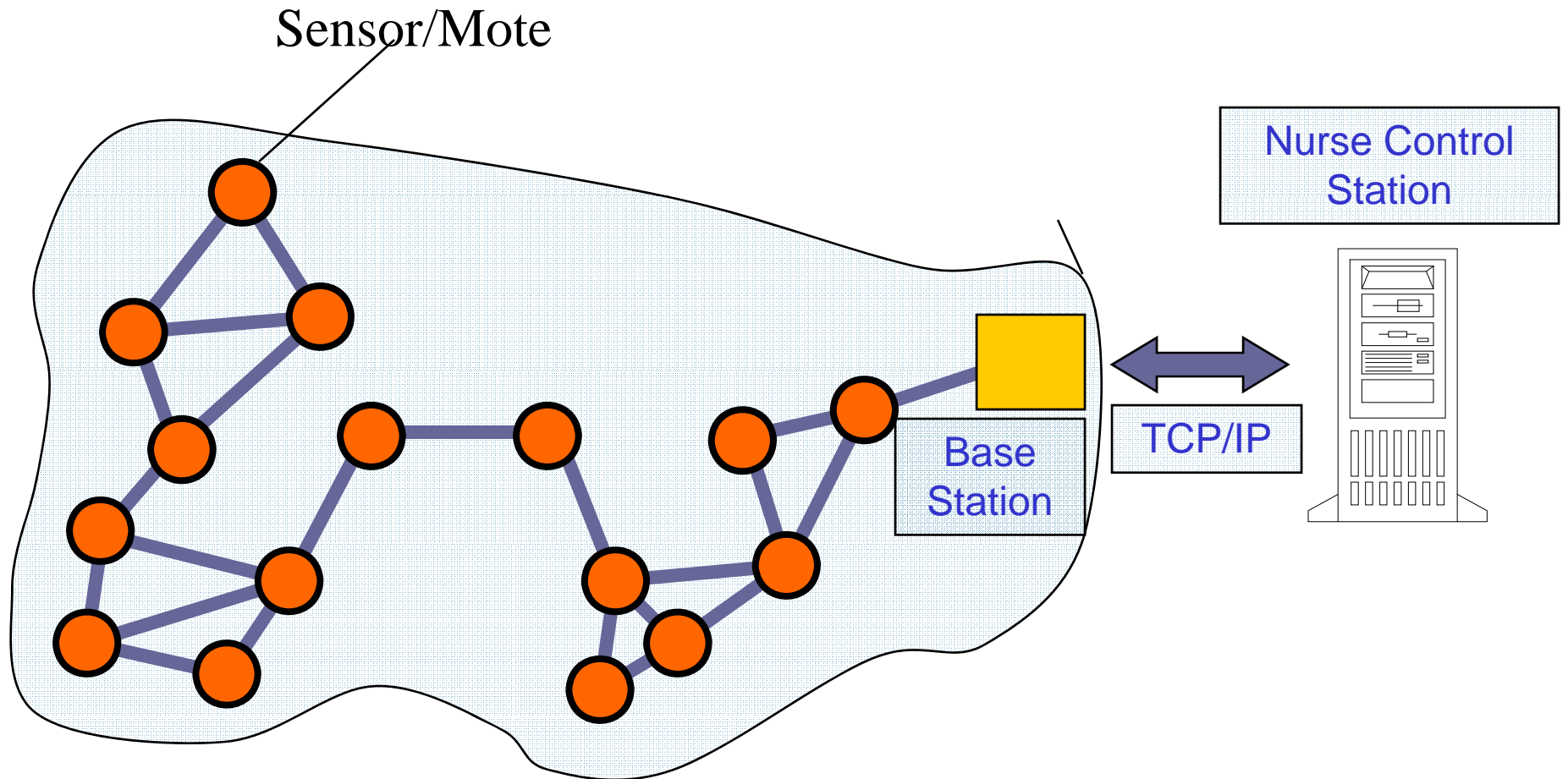


Processor/Radio Module



Base Station

Wireless Sensor Network Architecture



Project Activities

- Design a network of seven sensor/mote Nodes
- Program motes to sense physical phenomena like temperature, light, sound etc.
- Communicate sensed data to basestation via neighboring motes
- Display alerts or update data at nurse control station

Skills

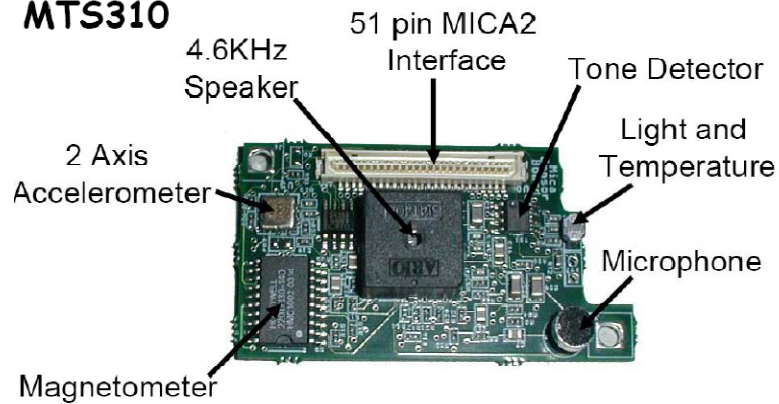
- 4 Electrical/Computer Engineering Students
- C/C++ Programming

Project 2 - A BODY ACTIVITY TRACKING SYSTEM USING WIRELESS SENSOR NETWORKS

- Overview
 - A body activity tracking system based on wearable accelerometers.
 - Measured accelerations are converted into angles of body segments System is applied to track ambulatory activities
 - Better than vision-based and magnetic sensor based approaches in tracking accuracy and smoothness

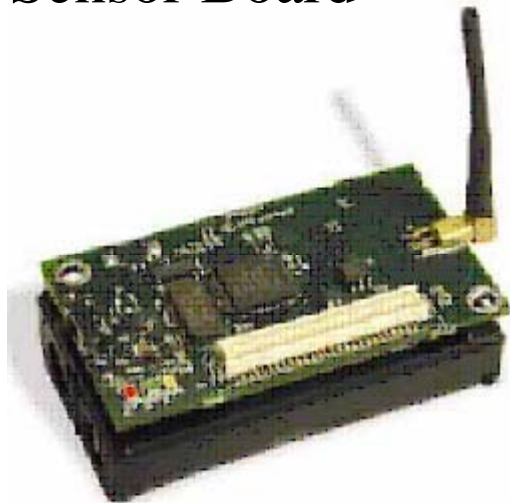
Wireless Sensor Network Hardware

Crossbow
MTS310

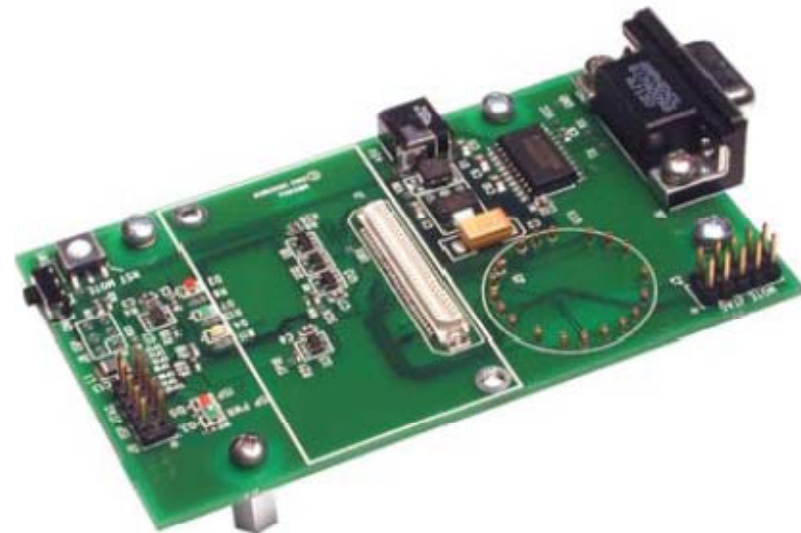


Sensor Board

- 7 Multi-Sensor Boards
- 7 Processor/Radio (Motes)
- 1 Basestation

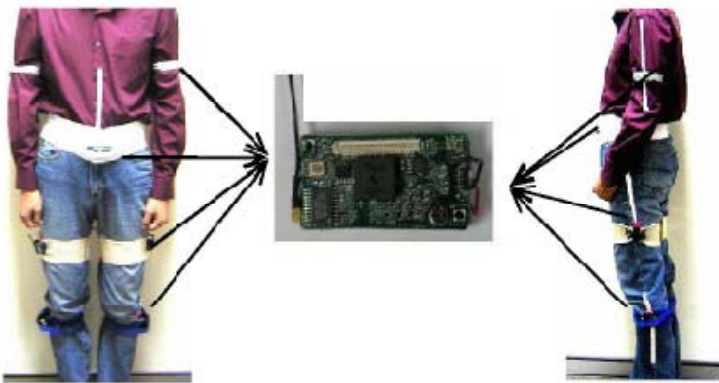


Processor/Radio Module



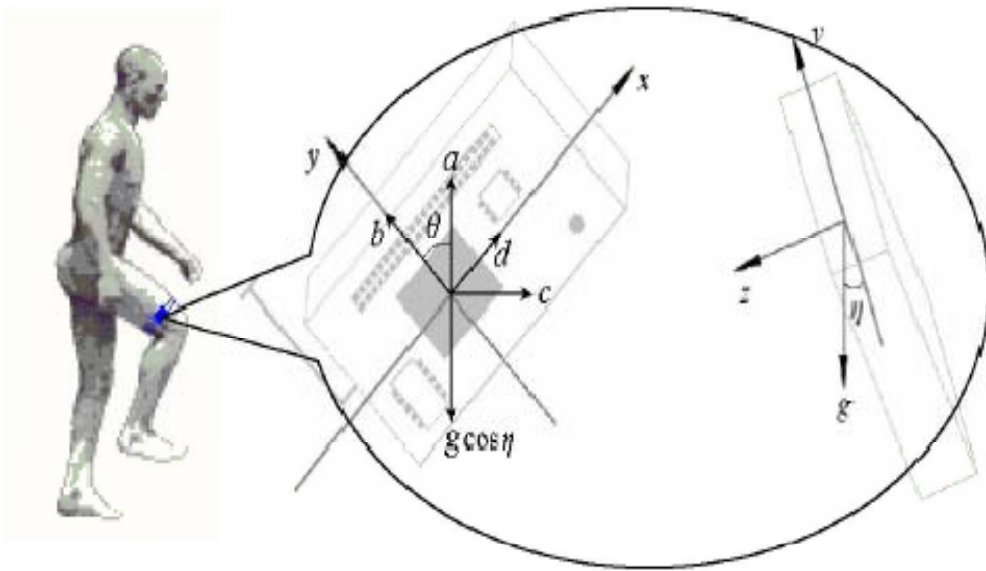
Base Station

Wireless Sensors placement



- Human body is built up with multiple mobile body segments.
- To track their movement, the positions of the component body segments must be learned.
- In the proposed system, this is realized by using wearable accelerometers that are attached at major body segments such as trunk, thighs, arms, etc.

Measurement and variables of the accelerometer



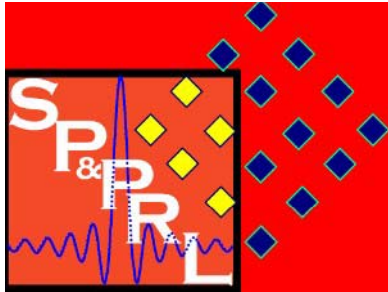
- The accelerometer sensors in the sensor board are used in the system
- When they are put into operation, accelerations are output continuously, i.e. x - and y -axis accelerations d and b .

Project Activities

- Design network of sensor/motes
- Sense and transmit acceleration data (x, y, z axes) from all the sensors to the server
- Implement a classification algorithm to identify several characteristic movements, such as falling, walking, running, sitting

Skills

- 4 Senior Electrical and Computer Engineering Students
- Digital Signal Processing
- C/C++ Programming



SIGNAL PROCESSING & PATTERN RECOGNITION LABORATORY

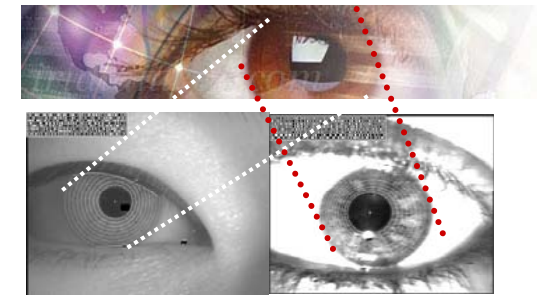
Fall 2008 – Clinic Projects

NEW!
in 2008

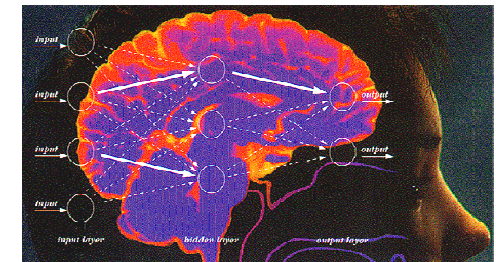


ECE -8
**Genomic Signal
Processing
&
Bioinformatics**

ECE -9
**Computational
Intelligence &
Machine Learning**

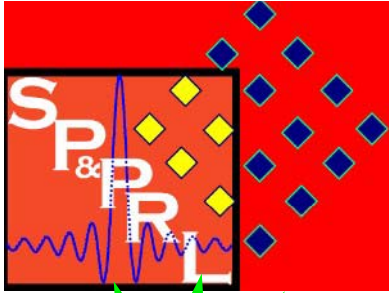


ECE -10
**Signal Processing
for
Early Diagnosis of
Alzheimer's Disease**



All three are research based projects – Strong algorithm development, communication and programming skills, knowledge of probability and statistics, signal processing and good command of MATLAB® will help you succeed.

These projects will lead to publications, conference travel (see last slide) and graduate assistantship. Future graduate funding is available from these projects if you show strong potential for success.



GENOMIC SIGNAL PROCESSING & BIOINFORMATICS



Does your genetic code trying to tell you something?
Are you at risk of a particular cancer?
Can you take the DFT of the genetic code to find out?

ECE -8

The answer to these questions is a very enthusiastic YES!!!
Explore and learn about this exponentially growing new area of signal processing

Project seeks **one or two ECE seniors**

Prerequisites: Successful completion of:
Digital signal processing, pattern recognition

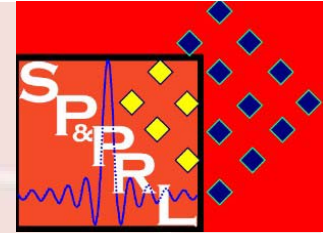
Good Matlab skills





MACHINE LEARNING & PATTERN RECOGNITION

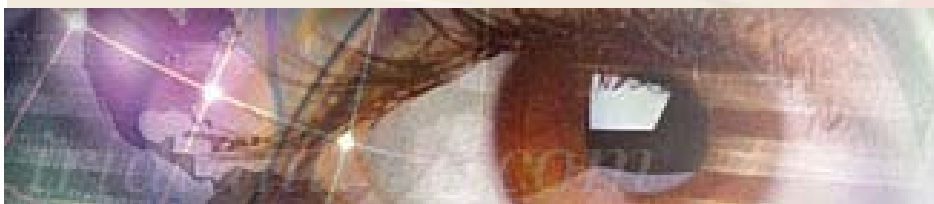
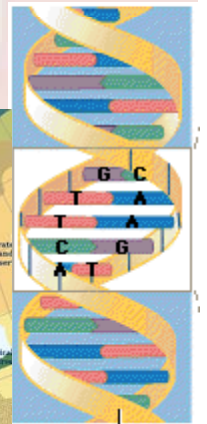
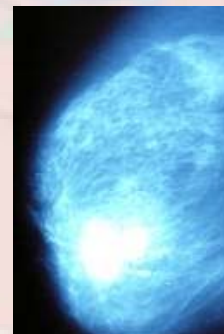
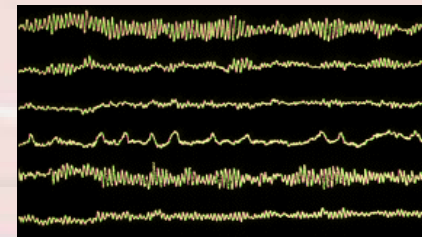
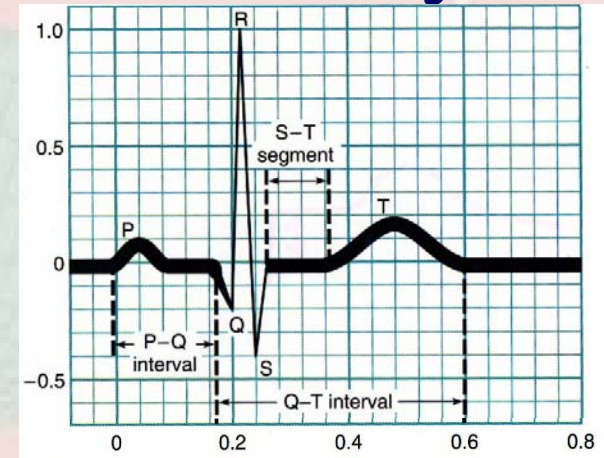
ECE -9



Automated identification of objects into a number of categories or classes through sophisticated data analysis.

Also known as Computational / Artificial Intelligence

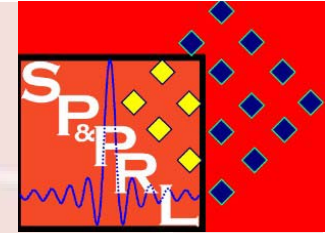
- Applications – a very brief / abbreviated list
 - Speech recognition / speaker identification
 - Hand written character recognition
 - Financial data analysis / stock picking / prediction
 - Loan / credit / mortgage applications
 - Finger print identification
 - DNA sequence identification
 - X-Ray Mammography test
 - Neuro / cardiological disorder diagnosis
 - Radar tracking, friend-foe identification
 - Biometrics / Iris scan identification
 - Topographical remote sensing
 - Text mining / web mining / search engines





MACHINE LEARNING & PATTERN RECOGNITION

SPECIFIC AREAS OF INTEREST

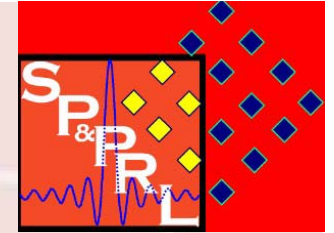


- **Development of machine learning, artificial and computational intelligence, classification algorithms for a diverse array of pattern recognition problems and applications.**
 - **Data Fusion**
 - **Learning in nonstationary environments**
 - **Bioinformatics (also note ECE – 08)**

ECE -09

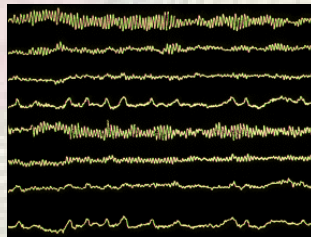


MACHINE LEARNING & PATTERN RECOGNITION DATA FUSION

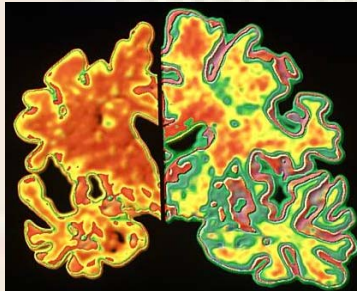


- How to combine data / information coming from different sources, imaging modalities or sensors, so that the combined data allows us to make better decisions.
 - Applications to medicine: Combine different diagnostic tests, such as EEG, MRI, PET scan, etc. to make a more accurate diagnosis of a neurological disorder

EEG



MRI



PET



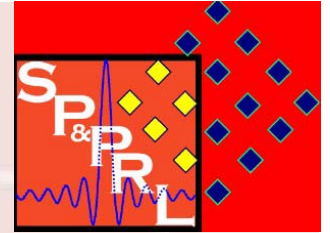
DATA
FUSION

Diagnosis

ECE -09



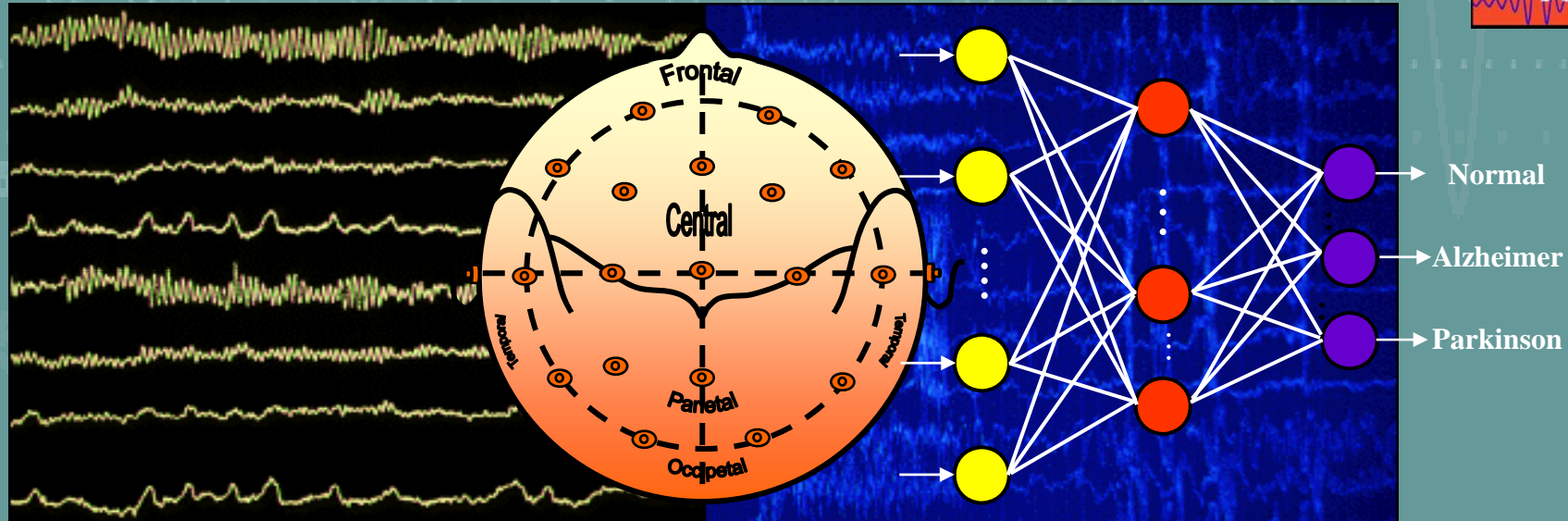
LEARNING IN NONSTATIONARY ENVIRONMENTS



- One of the most recent and heavily researched areas in machine learning
- How do you make a machine learn, if what needs to be learned changes while it is trying to learn...?
 - Spam detection
 - Medical diagnosis
 - Fraud detection

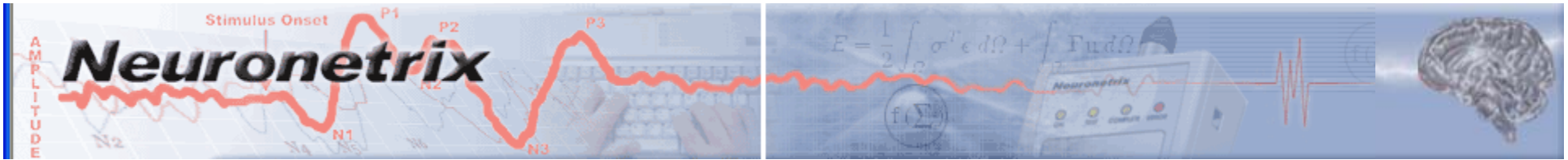
ECE -09

Goal- **SIGNAL PROCESSING FOR
EARLY DIAGNOSIS OF
ALZHEIMER'S & PARKINSON'S DISEASE**
ECE -10



- Literature review on Alzheimer and Parkinson disease
- Analysis of EEG signals to distinguish normal EEG from those with AD or PD → **Signal Processing**

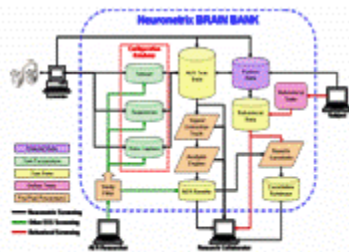
- Research based project.
- 2-4 ECE Se or Ju.
- ECE: Strong programming, communications and analytical thinking skills required. → MATLAB



- New partner: Neuronetrix, Inc.
 - Physical implementation of the entire hardware / software system
 - Signal processing and pattern recognition algorithms to be implemented by Rowan



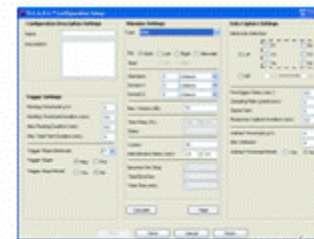
COGNISION™ System



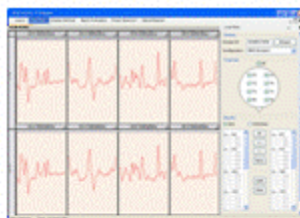
ERP-DATABASE



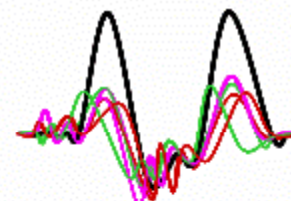
HEADSET



CONTROL PANEL

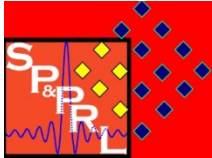


VIEWER

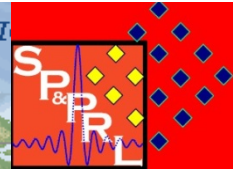


CLASSIFIER

ECE -10



SIGNAL PROCESSING & PATTERN RECOGNITION LABORATORY (SPPRL) CONFERENCE PRESENTATIONS (2001-2007)



- **Portland, OR***
- **San Francisco, CA***
- **Philadelphia, PA***
- Monterey, CA
- **Vail, CO***
- **Annapolis, MD***
- **Orlando, FL***
- **Prague, Czech Republic**

- **Sicily, Italy***
- Barcelona, Spain
- Amsterdam, NL
- **Montreal, QB***
- Budapest, Hungary
- Istanbul, Turkey
- London, UK
- Canterbury, UK
- **Honolulu, HI***

- **Shanghai, China**
- **Salt Lake City, UT**
- **Houston, TX***
- Toulouse, France
- Taipei, Taiwan
- Athens, Greece
- **New York, NY***
- Vancouver, BC

*** Presented by students**

Autumn 2008 Clinic Projects

Renewable Energy

26 August 2008

Dr Peter Mark Jansson PP PE

ECE # ___ PV Systems SJ Tech Park

- Need 2 ECEs
- http://suntechnics.com/us/welcome_1st.htm
- World's Leading Solar Integrator

The logo for SunTechnics, featuring the word "Sun" in yellow and "Technics" in grey, set against a light grey rectangular background with a drop shadow.

SunTechnics

- <http://www.pv.kaneka.co.jp/>
- World's Largest Amorphous PV Mfgr

The logo for Kaneka, featuring the word "KANeKA" in a stylized, blocky font with a blue and white color scheme.

KANeKA

ECE #__ PV Systems SJ Tech Park

- *The Project:*

Compare production, performance, efficiency of 3 active RU campus PV systems

1 –kW a-Si PV System @ SJTP

12 – kW Si PV System @ SJTP

2.5 kW MC Si PV System @ Team House

Many Other PV Systems including:

- Time Lapse Video of 3 MW system construction
- 2MW Seabrook design as well (largest in NJ)

ECE #__BlackLight Power

- <http://www.blacklightpower.com/>
- Calorimetry Validation Experiments
- SJ Tech Park Lab and BLP Labs

- *The Project:*

Perform RU Validation of their calorimetry experiments

LabView, MatLab, Calorimetry experience

Request is for 2 ECEs, 1 ME and 1 ChemE

Requirements for all

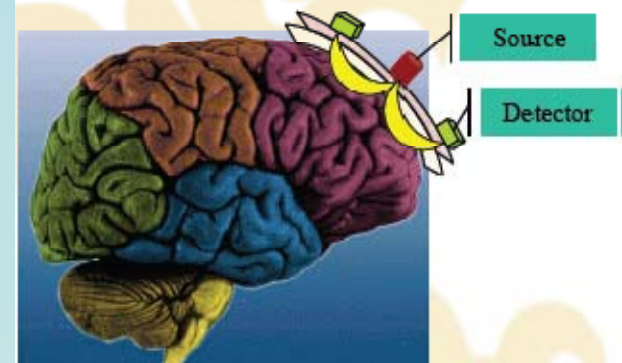
- MUST be willing to work some weekends and outside of normal clinic hours

Junior/Senior Clinic FPGA-based fNIR (functional Near InfraRed) Spectroscopy

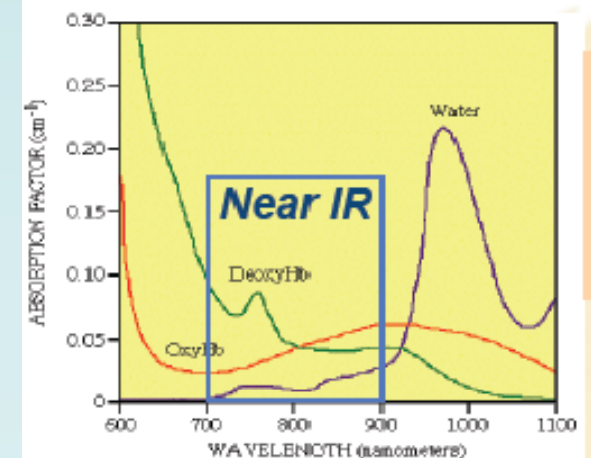
L. Head
ECE – Rowan University
Fall 2008

- PROJECT GOAL:
- To develop FPGA-based instrumentation for a “wearable” imaging system that will be used in medical diagnosis & monitoring applications where blood flow changes are used to assess function.
- This system is based on the absorption properties of near infrared light by oxy and deoxy-hemoglobin.
- The system incorporates
 - stimulus,
 - data acquisition,
 - signal processing, and
 - data transmission
 to replace the desktop instrumentation currently in use.

Photon Migration in Tissue



Optical Window in Tissue

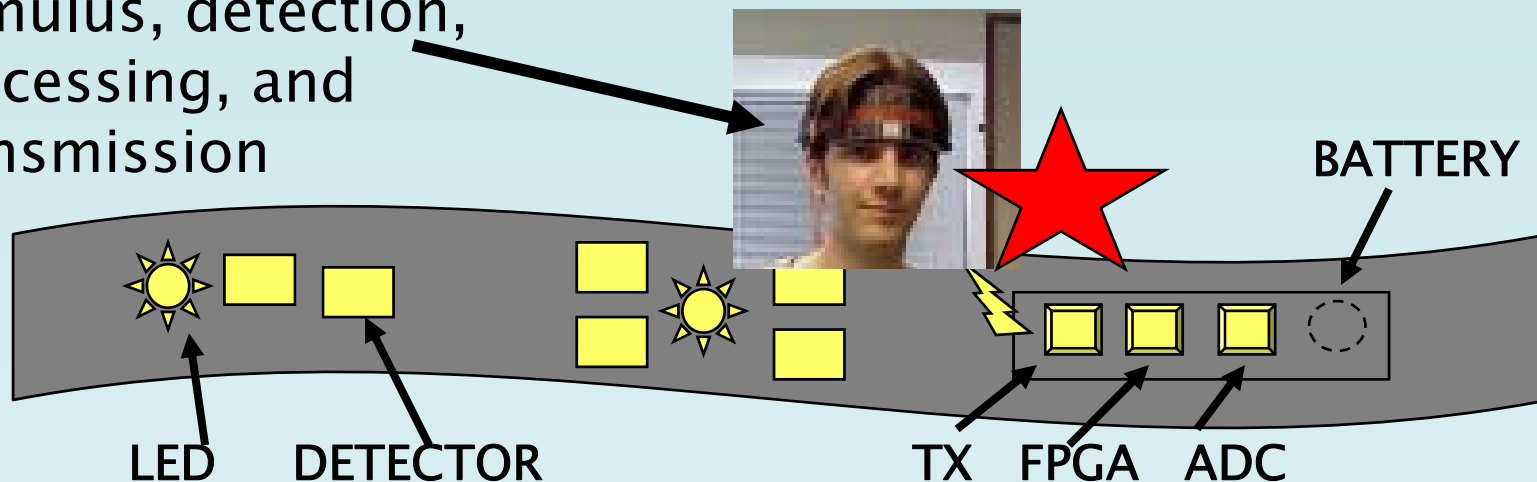


Making the transition from:

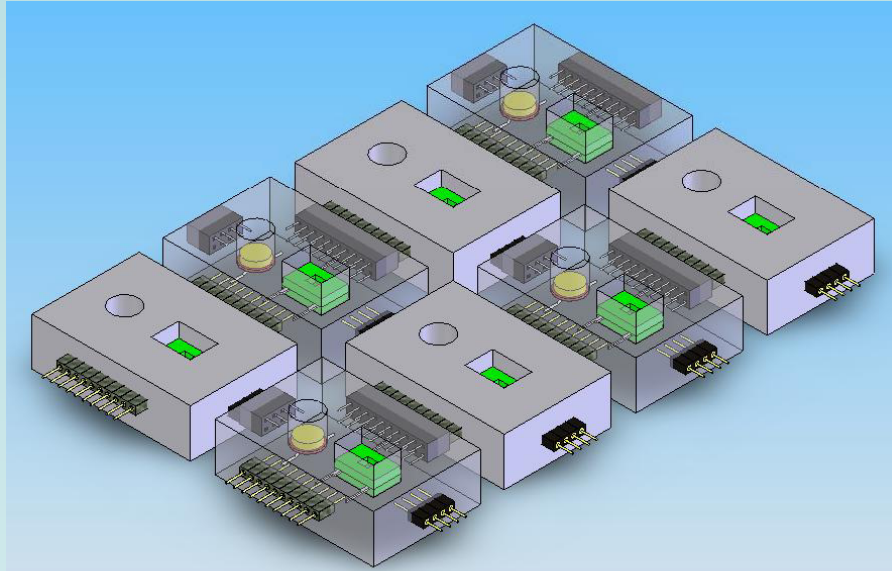
A desk-top, PC-based system



To a single headband system with on-board stimulus, detection, processing, and transmission

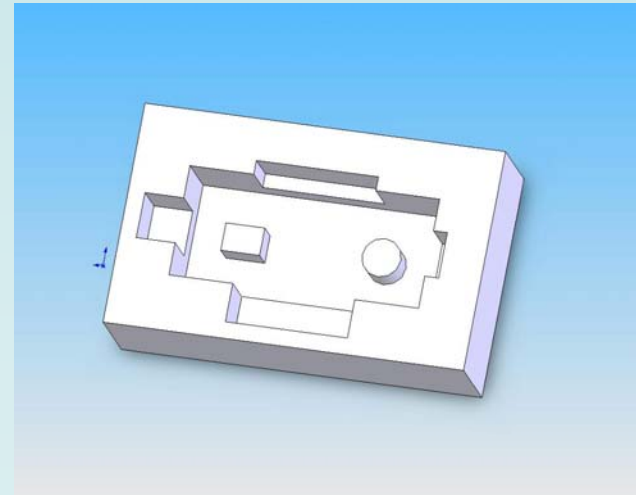
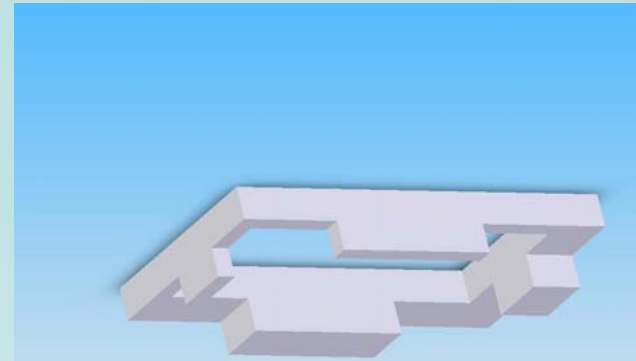


Sensor development – modular parts from molded rubber



Tasks:

1. Develop Solidworks models for new applications
2. Create molds for modular sensors
3. Investigate material properties for optimal sensor flexibility and interface with targeted areas of body (forehead – arm)
4. Develop attachment hardware that provides subject comfort and unrestricted motion



Junior/Senior Clinic

Instrumentation for Optical Imaging of Muscle Oxygenation

L. Head
ECE – Rowan University
with
Temple University
Fall 2008

➤ PROJECT GOAL:

- To develop single-channel wireless instrumentation for a “wearable” imaging system that will be used in medical diagnosis & monitoring applications where blood flow changes are used to assess function.

- This system is based on the absorption properties of near infrared light by oxy and deoxy-hemoglobin.

- The system incorporates
 - stimulus,
 - data acquisition,
 - signal processing, and
 - data transmissionto replace the desktop instrumentation currently in use.

- Current progress:
 - Single channel sensor developed and tested
 - Signal acquisition and transmission circuitry developed and tested
 - Wireless hardware tested
- Tasks
 - Signal conditioning (amplification)
 - Integration of wireless hardware



MULTIRATE FIR FILTERS

Ravi P. Ramachandran

Linda M. Head

Gina Tang



Objectives

- To develop software and hardware implementation of multirate FIR filtering operations and a QMF bank
- MATLAB, Mentor Graphics, FPGA Advantage (design, simulation and synthesis using VHDL or Verilog), ASIC
- Extensive simulation studies
- To write a technical report
- Two ECE students needed
- NSF funded

ROWAN
UNIVERSITY
College of Engineering



SPEECH

ENHANCEMENT

Ravi P. Ramachandran

Linda M. Head



Objectives

- To study and simulate the Cohen speech enhancement algorithm in MATLAB
- Perceptual quality of enhanced speech
- SNR estimates
- Speaker identification performance
- To write a technical paper on the research findings
- Two ECE student needed, one should be a senior

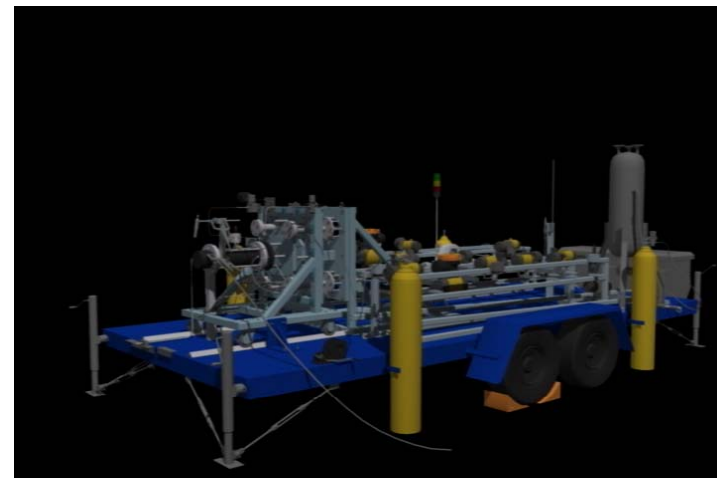
Virtual Reality (VR) Facilities at Rowan



Immersadesk® Semi-Immersive
VR Environment
(Room 201 Rowan Hall)



Reality



Virtual Reality

VR Simulation – Rowan Hall



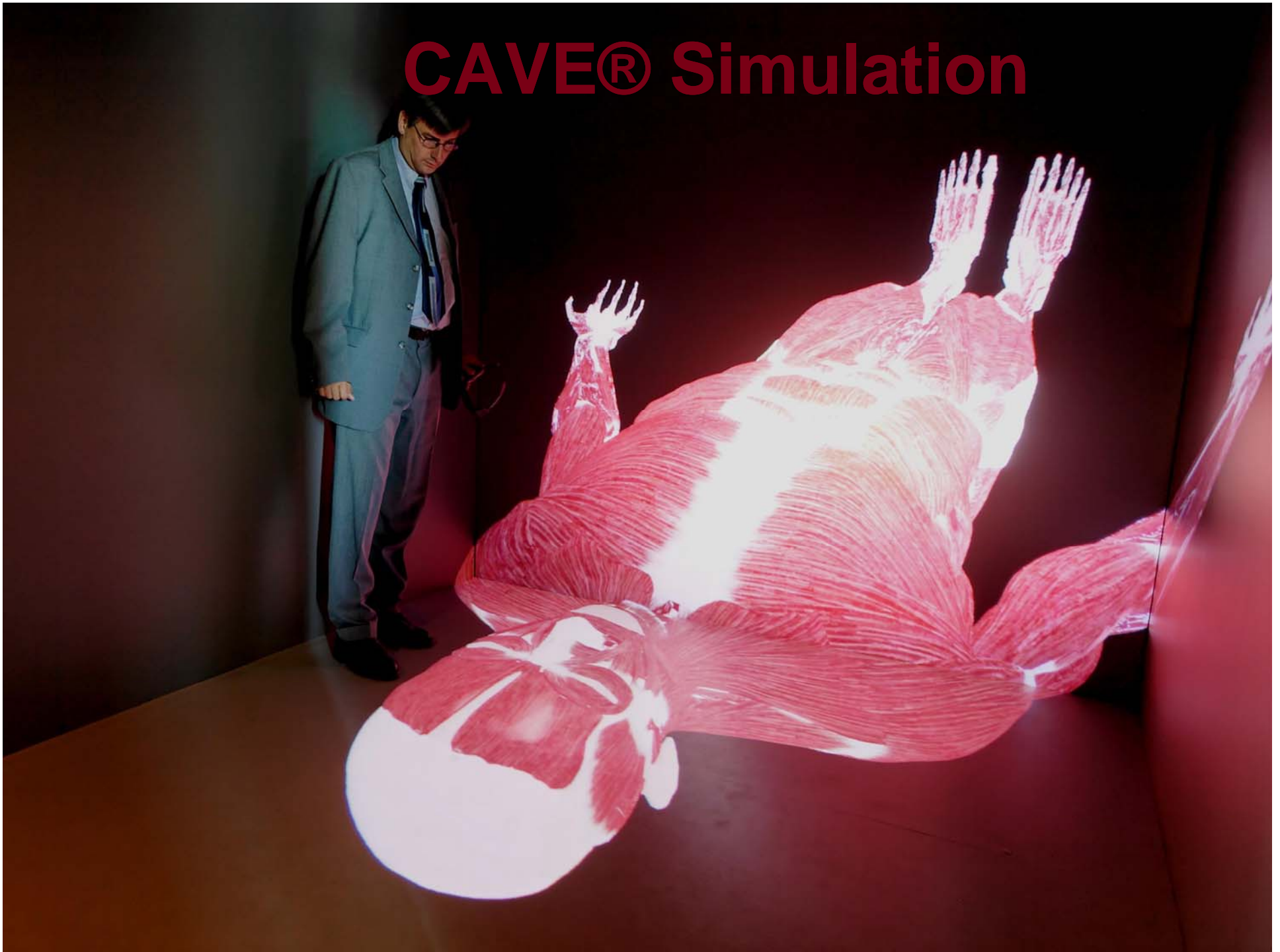
**Coming
Soon!**

The CAVE® at the SJTP



NSF Award # 0821070
June 2008

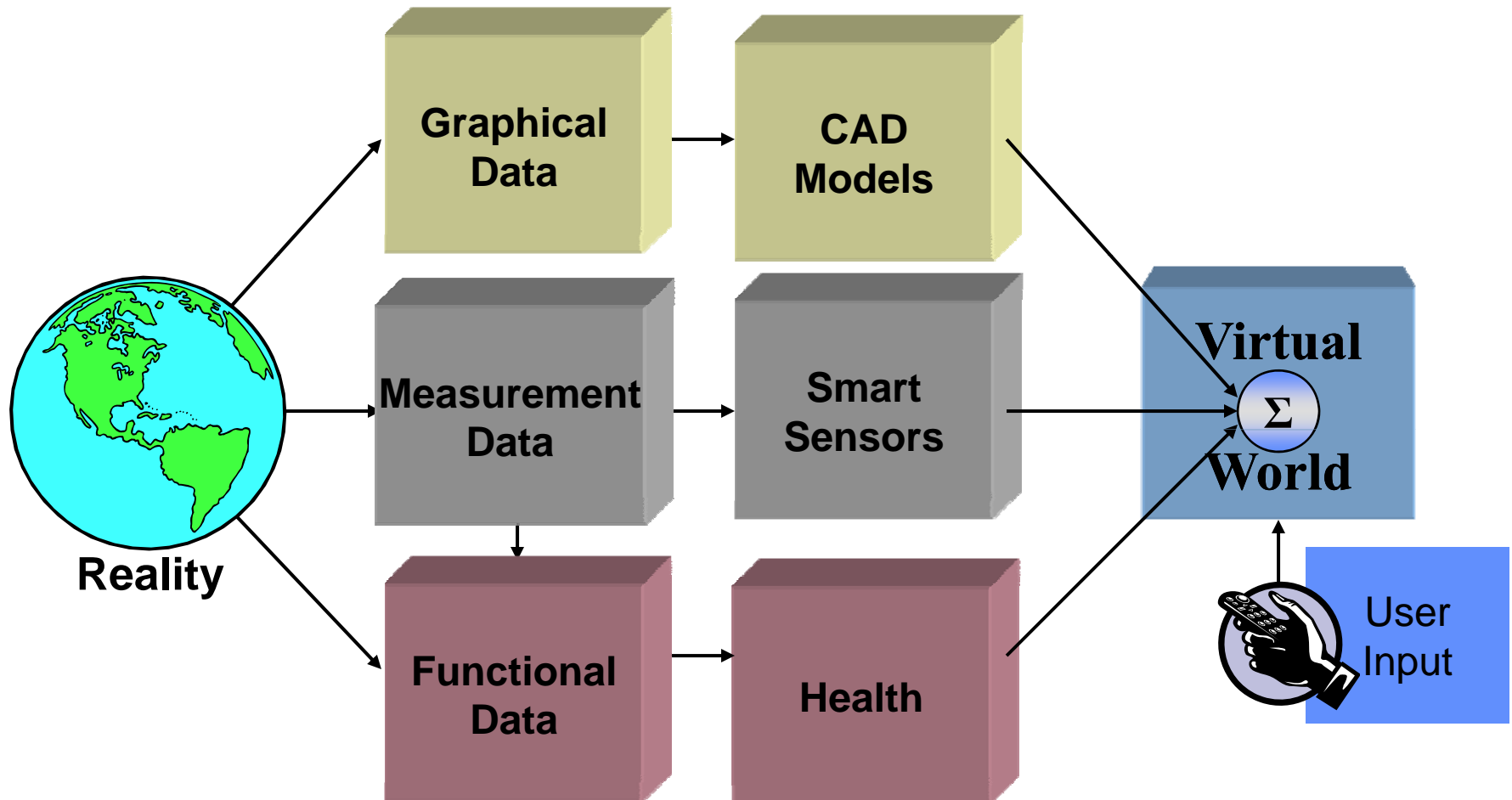
CAVE® Simulation



CAVE® Simulation



Virtual Reality (VR) Applications



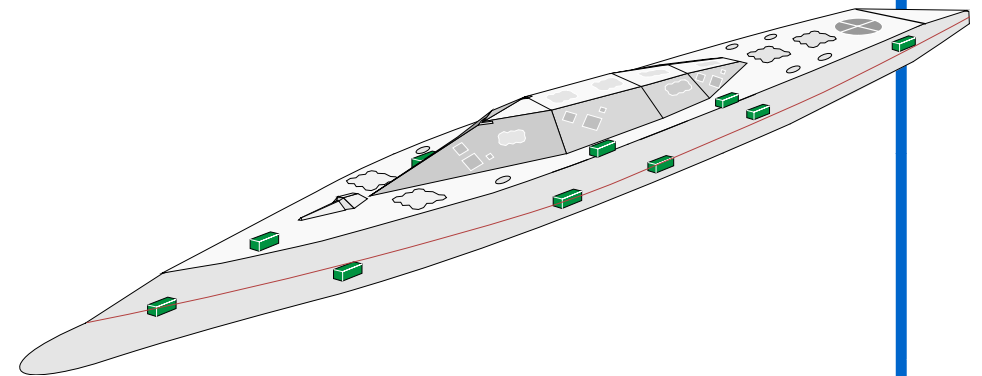
VR Projects in the CAVE®



Intelligent Valves for Integrated Systems Health Management



NASA-Stennis Space Center



Video Sensors for Ship-Board Systems



NAVSEA, Philadelphia