

# Center for Security Technologies

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- NSF-ERC Proposal Format
  - Personnel
  - Intellectual Thrusts
  - Engineering Testbeds
- NSF-ERC Timetable
  - Decision on Other Core Partners: ASAP
  - Nearly Complete Proposal Layout: April 15
  - Final Preliminary Proposal: May 15
  - Final Proposal December
- Reminder: Several Funding Sources Pursued

# NSF-ERC Proposal Plan

- Scientific and Technological Thrusts
  - Key Intellectual Content
  - Drive Educational Activities within Center
  - Contribute to Multiple Testbeds
  - Each Must be Equivalent to Fundable NSF Proposal
  - Thrust Leader Plus Several PI's
- Engineering Demonstration Testbeds
  - Key Engineering Demonstrations
  - Engineering Systems Synthesizing Multiple S&T Thrusts
  - Drive Industrial/Applied Activities within Center
  - Each Must be Equivalent to Fundable NSF Proposal
  - Testbed Leader Plus Several PI's
- Potentially Hard Decisions to be Made

# NSF-ERC Personnel

- Key Personnel from Across University: SEAS, A&S, Law, WUSM, GWBSSW
- Primarily SEAS Leadership
- Each contributes substantially to at least one thrust or testbed (preferably both)
- Decisions soon: role for others outside WU

# S & T Intellectual Thrusts

- Recognition Theory and Systems:
- Vision: **Pless**
- Advanced Electronic Systems: **Lockwood**
- Distributed Systems: **Roman**
- Computer and Information Security: **Hegde**
- Information Theory and Data Processing:
- Robust Systems: **Isidori**
- Sensors:
- Privacy and Policy:

# S & T Intellectual Thrusts

- Recognition Theory and Systems:
  - Biometrics-based recognition including face, fingerprint, retinal, DNA, etc.
  - Physical signature recognition including magnetic signatures
  - Fast database searching and recognition system implementation
  - Data and model compression, signal representation
  - System implementation considerations: processors, computation, communication, database design
  - Data mining, intelligence extraction, situational awareness
- Byrnes, Chamberlain, Franklin, Indeck, Martin, O'Sullivan, Grimm, Pless, Wickerhauser, etc.

# S & T Intellectual Thrusts

- Vision:
  - 3D Scene modeling
    - known or constrained scenes, unknown scenes
    - Texture, lighting, BRDF
    - Deterministic, stochastic
    - Natural scenery, man-made objects, known objects
  - Scene and camera motion, known and unknown
  - 3D registration
  - Smart cameras, embedded processing,
  - Optical, infrared, hyperspectral, radar imaging systems
- Fuhrmann, Ghosh, Grimm, Pless, O'Sullivan, Smart, Smith, Snyder, etc.

# S & T Intellectual Thrusts

- Sensors:
  - Optical Cameras: custom, high-end, off-the-shelf, frame-rates
  - Infrared, Multispectral, Hyperspectral Sensors
  - Biological and Chemical Sensors
  - X-ray, ultrasound, MRI, optical diffusion
  - Custom sensors such as fingerprint, retinal
  - Magnetic
  - Radar
  - Active, passive
- Brownstein, Fuhrmann, Hayes, Indeck, O'Sullivan, Pless, Smith, Snyder, etc.

# S & T Intellectual Thrusts

- Privacy and Policy:
  - Societal issues, security-privacy perception and reality
  - Economic issues, cost-benefit analysis
  - Legal issues
  - Technological solutions to privacy issues
- Clark, Drake, Drobak, Keiff, Martin, Rank, etc.

# S & T Intellectual Thrusts

- Advanced Electronic Systems:
  - Embedded processing
  - Reconfigurable electronics
  - Signal processing and VLSI design
  - Novel electronics including random number generation
- Chamberlain, Franklin, Lockwood, Morley, Richard, etc.

# S & T Intellectual Thrusts

- Computer and Information Security:
  - Hardware solutions to buffer control issues
  - Information assurance
  - Robust distributed database design
  - Information hiding, watermarking, steganography, fingerprinting
  - Distributed threat detection at network speeds
- Hegde, O'Sullivan, Xu, etc.

# S & T Intellectual Thrusts

- Robust Systems:
  - Robust control theory
  - Optimization theory
  - Dynamic vision
- Byrnes, Ghosh, Isidori, Mukai, etc.

# S & T Intellectual Thrusts

- Distributed Systems:
  - Distributed sensors, computation, communication, data storage (sensor, computer, communication, and data networks)
- Cytron, Gill, Roman, Xu, etc.

# **Engineering Demonstration Testbeds**

- **Searching Massive Databases for Critical Information**
- **Networks of Wireless Sensors**
- **Networks of Video Cameras**
- **Biometrics-Based Recognition Systems**
  
- **Additional potential testbeds:**
  - **Computer Security**
  - **Biological and/or chemical sensing, preferably distributed**
- **Roles of Privacy and Policy in Testbeds?**

# NSF-ERC Timetable

- Preliminary Proposal May 15
- Complete layout of proposal April 15
  - All thrust descriptions in, 2-3 pages each
  - All testbed descriptions in, 2-3 pages each
  - Introduction, motivation, unique contributions in, 4 pages total
- Complete draft of proposal May 1
- Preliminary budget April 15, Final Budget May 1
- All NSF PI data submitted on Fastlane by April 22
- Implement Engineering Design Testbeds over summer

# Reminder: Other Opportunities

- State level: Tim Daniel, Dennis Roedemeier, Center for Environmental Studies, Senators Bond and Carnahan, National Center of Excellence in Homeland Security
  - Build collaborations with UMR, UMC, UMSL, SLU
  - Dave Richard leads statewide effort
- Working with Cindy White to identify opportunities
- Powerful Advisory Board may yield other opportunities

# Engineering Demonstration Testbeds

- **Searching Massive Databases for Critical Information** A general testbed for performing complex searches on massive databases will be implemented. The use of reconfigurable logic permits the development of searching hardware tailored to application requirements and to perform these searches at much higher speeds than are possible with conventional approaches. A prime example is complex searching of large web-derived text streams and images. Placing the logic devices physically adjacent to high-density storage systems permits orders of magnitude increases in speed. In many applications, we envision sensors on the front end that acquire mass spectrometry data at a relatively high rate. Massive databases of ideal or sample spectra may be searched rapidly to find candidate matching spectra.
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- **Networks of Wireless Sensors** Wireless technology makes it possible to consider configuring networks out of components that have the ability to communicate via radio, infrared, or optical signals whether these components are static or mobile. People can interact with each other and with such ad hoc networks as they are within proximity. The engineering testbed will include deploying wireless sensors and implementing software technology for context aware computing in both the static and mobile situations. Security research relating to this area is in its infancy.
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- **Networks of video cameras** Complex three-dimensional scenes will be viewed from multiple angles using fixed and mobile cameras. Video data from fixed camera positions will be combined to find models of objects and actions occurring in the scene. The advantages and trade-offs between local and centralized computation will be explored in a rigorous fashion, including a detailed analysis of algorithms for the case of low bandwidth communications between sensors. The advantages of having mobile cameras, and algorithms for accurately determining their positions, will be explored as well. Complex scenes with unknown and varying backgrounds will be considered, as well as more

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# Biometrics-Based Recognition Systems

- Fingerprint modeling, recognition, and performance analysis
- Face
- We propose to further develop imaging science and the science of recognition systems. A recent court decision and its subsequent reversal determining that fingerprint recognition as practiced in the United States today is not a science highlights the need for the research community to provide needed scientific underpinnings. For this instance the foundations of such a science lie in a combination of physical models for the biometric signature sensed, a quantitative model for the data collected from the signature, and a scientific basis for predicting the performance of the resulting system. Our previous work in imaging science, physical signature authentication, and forensics provide a solid foundation for working on this problem of critical national need. We have worked on voice recognition, fingerprint recognition, and face recognition systems. The engineering testbed will have two primary components, one based on fingerprint recognition and one based on face recognition.

