The Center for Security Technologies

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Washington University and the Center for Security Technologies

- Washington University
  - *USNWR*: highly ranked nationally, top 10 in endowment
  - 8 Schools: Medicine, Social Work ranked in the top 3
  - SEAS: 6 departments including ESE and CSE

- CST
  - Interdisciplinary Academic Research Center
  - Formed early 2002
  - Built on existing strengths in security research
CST Mission

To advance through research in basic science, mathematics, and engineering those areas which can most directly improve security including:

- physical aspects of security (intrusion detection, biological and chemical substance identification)
- information aspects of security (networking, information awareness, and information theory)
- law, economics, public policy
CST Scope

- An interdisciplinary center
  - 40 faculty from five schools
  - More than cybersecurity
  - More than counterterrorism
    - A variety of ‘attacks’ including natural disasters
    - Integrate research through testbeds
- Synergy between technology and policy
  - Privacy/public policy as ‘design criteria’
Scientific and Technological Intellectual Thrusts

- Sensors: Indeck
- Advanced Electronic Systems: Lockwood
- Information-Theoretic Signal and Image Processing: Snyder
- Recognition Theory and Systems: O’Sullivan
- Vision for Security: Pless
- Distributed and Mobile Systems: Gill
- Network and Information Security: Hegde
- Detection, Isolation, and Accommodation of Faults: Isidori
- Privacy, Public Policy, and Economics: Kieff

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Engineering Demonstration Testbeds

- Systems Integration
- End-to-end Demonstrations
  - Biometrics/Physics-Based Recognition Systems: Morley
  - Searching Massive Databases for Critical Information: Chamberlain
  - Networks of Video Cameras: Pless
  - High Speed Network Security: Lockwood
  - Security of the Food and Water Supply: Smith
- Roles of Privacy, Economics, and Policy

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Example: Document Authentication

- Important documents
  - Airline tickets, passports, checks, currency, government issued IDs, product labels
- Use *magnetic signatures* to authenticate
  - Physical phenomena, sensor, signal
- How to authenticate
  - Algorithms, sampling, confidence
- Implement the system
  - Electronics, data management
Exploit Fundamental Science

- Using magnetic signatures for:
  - Tamper-evidence for containers
  - Physical access/bank cards
  - Software protection
  - Detect manipulation of data
  - ...
Related Recognition Systems

- What to authenticate?
  - Consider biometric:
    - Fingerprinting
    - Voice authentication
    - . . .

- Recognition systems share commonalities
  - Framework, performance analysis
Another Example/Opportunity: Data Explosion

- Humanoids have produced 12 Exabytes over the past \( \sim 30,000 \) years
  \( (12,000,000,000,000,000,000,000 \) Bytes)\)
- We will generate next 12 Exabytes in just over a year!
- US intelligence collects data equaling the printed collection of the US library every day!
Intelligent Searching of Massive Databases

- Fast, inexpensive searches for changing databases
  - 200 times faster than conventional searches
- Scalable, using conventional drives
- Search need not be exact
- Reduced bus demands
- Wide applicability:
  - Intelligence
  - Images
  - Genomics

DataSearch Systems, Inc.

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IBM

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Data Transmission

- 120 TBytes/sec internet peak rate
- 120 PBytes/month Internet
- 100 PBytes/month telephone
Network Watchman

- Electronic postmen
  - direct packets to destination via headers
- Secure network
  - watch headers
  - view payload
  - copy/redirect/stop packets
Digital Array Scanning Interferometer (DASI)

Applications to:
- Food supply
- Transportation
- Mail
- Currency
- . . .
Smart Borders – Smart Cameras
Mission Critical Areas

1. Intelligence and warning
2. Border and transportation security
3. Domestic counterterrorism
4. Protecting critical infrastructure
5. Defending against catastrophic threats
6. Emergency preparedness and response

CST’s Strengths Support the National Security Agenda
“The Department will have a clear, efficient organizational structure with four divisions:

1. Border and Transportation Security
2. Emergency Preparedness and Response
3. Chemical, Biological, Radiological, and Nuclear Countermeasures
4. Information Analysis and Infrastructure Protection”

CST addresses many Science and Technology issues of the Homeland Security Act
CST Funding/Collaborations

developed and developing

- NSF, DoEd
- ARO, DARPA, ONR
- CIA, FBI, NSA
- NIST - ATP
- Battelle, SRI
- Boeing, CSFB, Monsanto, SBC . . .
CST External Advisory Board

Mr. Earle Harbison (retired President and COO, Monsanto), Chair
Dr. Massoud Amin (Director of Infrastructure Security, EPRI)
Dr. Allen Atkins (VP, Boeing)
Dr. Tony Cantu (Chief Scientist, US Secret Service)
Prof. Jerry Cox (Senior Professor, Washington University)
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Dr. Joe Leonelli (Director, Battelle)
Ms. Jan Newton (President TX, SBC)
Gen. Tony Robertson, (Fmr. Com. in Chief, Air Mobility Command)
Dr. Don Ross (Chairman, Ross and Baruzzini: Cernium)
Hon. William Webster (retired Director, CIA and FBI)
CST’s Unique Strengths

- Broad Range of Research and Applications
  - Sensors through signal processing to implementations
  - Security of food, water, access, network, borders
  - More than cybersecurity
- Synergy between Technology and Policy
- Systems Integration
Established critical mass in security technologies
Many complementary projects
Widespread applications
Fundamental scientific and engineering issues
Guiding standards and impact policy
Uniquely integrating economic and privacy issues
Synergy between WUSTL, region, and nation
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Comprehensive Scientific and Engineering Resource

www.cst.wustl.edu
CST Membership Benefits

- Access to Laboratories, Professors, and Students
- Early Access to Intellectual Property and Technology Development
- Ability to Conduct/Direct Research On-Site
- Synergistic Collaboration with Other Companies on Precompetitive Research
- Access to Students for Employment
  - Co-op and Post-Graduate
CST Membership Benefits

- Rapid Prototyping
- Access Unique, Large Experimental / Computational Facilities
- Input to Technical Reports
- Annual Progress Reports
- Biannual Briefings
  - May and January
Technology Transfer

- Wavelet-Based Compression for Fingerprint ID (AFIS)
- Magnetic Signature Development
- Automatic Target Recognition
- High Speed Network Content Matching
Ongoing/Developing Research

- Intelligent Searching of Massive Databases
- Sensor Networks
- Network and Data Security
- Secure Code Development
- Security of the Food, Mail, and Currency
- Vision for Security
- Biometric-Based Authentication
- Public Policy
Sensor Networks

- Networks of Sensors
  - Sensing, communication, control
- Intelligently Combine Data from Multiple Sensors
  - Potentially widely distributed
- Communication Strategies and Protocols
  - Compression, localization, wireless
- Control of Sensors
  - Asynchronous communication
  - Sensor parameters
Networks of Distributed Sensors

- Existing or Future Sensor Networks
- Networks of Sensors
  - Waterway: detect pollution, bioterrorism, chemical spills
  - Building: fire, temperature, other agents
  - Cameras: dynamically reconfigure
  - Communicate problems, identify source
  - Real-time response to evolving situations
X-ray Scanning and Security Imaging

Conventional Transmission
Scanning at Borders/Airports

Low Energy Backscattered

Behavior Analysis

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Network of Video Cameras

- Missouri RapidScreen
- License Plate ID System
  - consider sniper case
Privacy, Public Policy, and Ethics

- Societal Issues, Security-Privacy Perception and Reality
- Economic Issues, Cost-Benefit Analysis
- Legal Issues
- Technological Solutions to Privacy Issues
- Facilitate Discourse on Technology and Its Implications