

Moncrief-O'Donnell  
Endowed Chair  
2005 Annual Report

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The **Moncrief-O'Donnell Endowed Chair in Robotics** was filled in October of 1990 with the hiring of Dr. Frank L. Lewis. Dr. Lewis established the Advanced Controls and Sensors Group (ACS) of the Automation and Robotics Research Institute immediately on his arrival.

## ACS PROGRAM OVERVIEW

The ARRI Advanced Controls and Sensors (ACS) Group consists of Dr. Lewis, 7 Ph.D. students, masters and undergraduate students, and intermittent visiting research faculty. The primary thrusts of ACS are research in controls design for robotic aerospace, and manufacturing systems, intelligent control, Wireless Sensor Networks, and real-time control implementation.

Lewis has graduated 29 PhD students. Most of these students have won international and local awards for their work, and several have written books and received US patents.

Eight SBIR contracts have been received from DoD to work with small companies to transfer technology developed at ARRI. Funding in excess of \$6 million has been received from Texas State, the National Science Foundation, and the Army Research Office to perform research and develop technology in Intelligent Control Systems, Industrial Control, and Vehicle Control Systems.

### **Wireless Sensor Networks**

*WSN are needed for fast deployment in areas that could be compromised due to security threats, equipment failures, or biochemical toxins.*

*Funding of \$78K from NSF and \$25K from National Instruments, Inc. was received for the WSN Testbed at ARRI. We are working with Texas A&M Corpus Christi to get funding in underwater monitoring for security and the environment.*

### **\$600,000 IN NEW FUNDING**

**During the past few months significant new funding was received by Lewis:**

- **“LabVIEW Applications for Wireless Sensor Networks,” National Instruments, Inc., Lead User Program, \$25,000.**
- **“Wireless Sensor Network Development System for Security, BDA, and Biochemical Monitoring,” Army Research Office DURIP equipment grant, \$78,741.**
- **“Nonlinear Motion Control for DoD and Industrial Systems,” ARO grant, \$260,000 for 3 years.**
- **“Adaptive Critics for Nonlinear Continuous-Time Systems,” NSF grant, \$240,000 for 3 years.**

The three missions of ACS group are:

- *To help companies improve their competitive advantage through advanced controls that increase product quality and production flexibility*
- *To perform high quality scientific research that expands the manufacturing science base*
- *To maintain a superior controls curriculum in the UTA Department of Electrical Engineering.*

**Wireless Sensor Networks.** This year we received \$100K in funding from NSF and National Instruments, Inc., for the WSN testbed at ARRI that has mobile robot sentries as well as unattended ground sensors for Secure Area Assurance.

The purpose of the ARRI WSN testbed is Research and Development in procedures and algorithms for fast deployment of WSN for security and environmental monitoring.

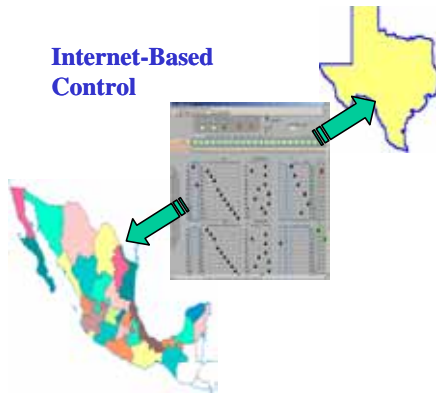
We have developed a WSN Supervisory Control System on a laptop PC using our patented Matrix Controller that can sequence tasks in dynamical changing environments based on sensor surveillance readings in real-time. This controller allows fast deployment and setup of WSN for remote site monitoring.

### **ARRI Distinguished Lecture Series**

This series was initiated and is run by the Moncrief-O'Donnell endowed Chair. Top Scientists from around the world visit ARRI, significantly expanding the reputation of UTA. This year's visitors include:

- V. Kucera, President, International Federation of Automatic Control; Dean of Engineering, Czech Technical Institute.
- P. Fleming, Vice President, Int. Federation of Automatic Control; Editor-in-Chief, Int. Journal of Systems Science; Pro-Vice-Chancellor for External Affairs, University of Sheffield, UK.
- O. Kaynak, UNESCO Chair of Mechatronics, Bogaziki Univ., Istanbul; Past President IEEE Industrial Electronics Society; Vice President, IEEE Neural Networks Society.

**Nonlinear Control Algorithms.** Neural Networks significantly improve the response time and accuracy of systems including vehicle autopilots, aircraft control systems, industrial positioning systems, robots, and DoD military platforms. This year two Ph.D. students and 2 Masters students were graduated. Two books are nearing completion.



### Keynote Speech Invitations

Lewis was invited to deliver keynote plenary talks at three international conferences:

- International Symposium on Neural Networks, Dalian, China.
- Int. Symposium on System Structure and Control, Oaxaca, Mexico.
- Int. Conf. Control & Automation, Budapest.
- Int. Joint Conf. Neural Networks, Montreal, Canada.

### Awards

Lewis is listed in:

- Ft. Worth Business Press, Who's Who in Manufacturing, Top 200 Leaders
- Who's Who in the World
- Who's Who in America
- Emerging Leaders in America
- Who's Who in Science and Engineering
- Who's Who Among America's Teachers

### EDITORSHIPS

Dr. Lewis was selected as:

- Editor, Marcel-Dekker book series on Control Engineering.
- Editor, Transactions of the Royal Institute of Measurement and Control.
- Editor, Optimal Control Applications and Methods, John Wiley Journal.

### SIGNIFICANT EVENTS THIS YEAR

- \$600,000 in new funding was received.
- Two top Ph.D. students and 2 masters students were graduated.
- Three International Visiting Scientist were hosted from China, Italy, and USA.
- Four journal papers, 3 book chapters, and 18 conference papers were published.
- Lewis was invited to deliver keynotes at 4 international events.
- Organized the ARRI Distinguished Lecture Series to invite international scientists to UTA to increase its visibility.
- Received \$100K from NSF and a company for the Wireless Sensor Networks Lab at ARRI.
- Three new textbooks in progress.
- Established international relations with Singapore to set up joint educational/training programs in Hard Disk Drive Control and Factory Automation.
- Lewis was appointed to three international editorship positions.

### International Activities

This year we received \$17K in off-site supplementary funding for R&D with National University of Singapore for research in Hard Disk Drive Control and Helicopter Control.

The objective is to train students for research in important industry-relevant areas, and to enhance the reputation of UTA internationally. Most hard disk drive companies today operate out of Singapore.

Our patented supervisory controller was used in a warehouse automation project at Singapore's Changi International Airport.

### DFW LOCAL IMPACT- PATENTS AND TECHNOLOGY TRANSFER TO U.S. SMALL BUSINESSES

ACS has contributed to the reputation within the scientific community of both UTA and Dallas/Ft. Worth. Lewis is listed in the Ft. Worth Business Press top 200 Leaders. He served as Founding Chairman of the DFW IEEE Control Systems Chapter, which won the national best chapter award in 1994. He was selected as Fort Worth Engineer of the Year by the IEEE Section in 1995. We have received four U.S. patents and filed one more. We have received significant funding from NSF, ARO, Texas State, and the DoD SBIR program to work with local and national industry. This has enhanced the competitiveness of DFW and U.S. companies in the area of feedback control systems, automation, MEMS, and Wireless Sensor Networks.

### Mexico/USA Activities in MEMS Microsystems



Micro-electro-mechanical Systems (MEMS) are the next step in the Silicon Revolution that began with the transistor in 1957. These are devices the size of a human hair that open new doors for in vivo biological health monitoring, sensors for toxic gases and agents, machinery health monitoring, and elsewhere.

Dr. Jose Mireles, former student of Dr. Lewis and currently a Professor at Univ. Autonoma de Ciudad Juarez, and a Research Professor at UTA, has organized significant activities in MEMS:

- Received extra funding from NSF.
- Mexico/Texas joint MEMS Conference, Veracruz, Mexico.
- Texas Systems Day organized at UT El Paso.