

Moncrief-O'Donnell
Endowed Chair
2007 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 33 PhD students. Most of these students have won international and local awards for their work, and several have written books and received US patents. Three are NSF Career Awardees.

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. Eight SBIR contracts have been received from DoD to work with small companies to transfer technology developed at ARRI.

Arlington ISD Engineering Technology Program and High School Student Summer Outreach Program

We work with Diane Brewer at Arlington Independent School District to host her high school Engineering Technology Students at ARRI.

We work with Diane and also Melissa Grubb at the Oakridge School to run a summer high school outreach program, where top students spend 2 weeks at ARRI working on robotics and control systems, learning skills in engineering that will be important for their college and their future careers.

SBIR Contract in Intelligent Fault Diagnostics. We received a \$33K contract from Dr. Chiman Kwan, CEO of SignalPro., Inc., to help develop Intelligent Diagnostics Tools for fault diagnosis in electrical power systems. This SBIR was awarded by The U.S. Dept. of Energy.

PhD Student Graduates

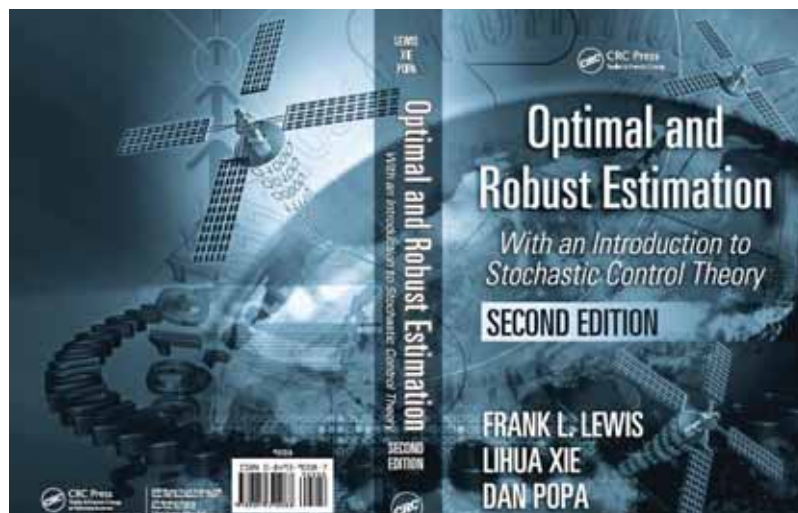
Three PhD students were graduated.



Dr. Cheng Tao published 6 journal papers from his work on intelligent neural network controllers for industrial and aerospace systems. He now works at Electric Reliability Council of Texas, Austin.

Dr. Asma Al Tamimi worked on neural network nonlinear control systems to improve performance of robotic and manufacturing systems. She is now an Assistant Professor at Hashemite University.

Dr. Jyotirmay Gadewadikar worked on designing improved structured autopilots for helicopters. He is now an Assistant Professor at Alcorn State University in Mississippi.



Hard Disk Drive Control

The storage density requirements for computer hard disk drives are increasing with the push for miniaturization of mass storage for portable handheld devices, including cellphones, MP3 music players, and laptop computers. Dr. Lewis and his students have worked with Data Storage Institute in Singapore to develop nonlinear control systems with improved performance in the presence of shock and motion disturbances. Improvements in position error have been on the order of 22%.



1.8" HGST Computer Hard Disk Drive for Portable Handheld Devices

Keynote Speech Invitations

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

- Invited Speaker, IEEE Int. Conf. Nano/Micro Engineered Systems (IEEE-NEMS 07), Bangkok, Thailand, Jan. 2007.
- Keynote Speaker, Int. Symp. Approximate Dynamic Programming and Reinforcement Learning, Honolulu, April 2007.
- Plenary Panel on Control Research and Education, Int. Conf. Control Applications, Guangzhou, May 2007.
- Plenary Speaker, International Conference on Life System Modeling and Simulation (LSMS), Shanghai, Sept. 2007.

EDITORSHIPS

Dr. Lewis serves as:

- Editor, Taylor & Francis book series on Control Engineering.
- Editor, Transactions of the U.K. Institute of Measurement and Control.
- US Region Editor for Int. Journal Intelligent & Robotic Systems

SIGNIFICANT EVENTS

THIS YEAR

- \$500,000 in ongoing funding from National Science Foundation, the Army Research Office, and Texas ATP Program.
- Three PhD students and 1 MS student were graduated.
- One book was published.
- Eleven journal papers and 23 conference papers were published.
- Started a new lab for autonomous UAV helicopter control.
- Received a Small Business Innovation Research contract from Dr. Chiman Kwan at Signal Pro., Inc., to help develop intelligent diagnostics for electric power system faults.
- Lewis was invited to deliver keynote talks at international events.
- Three of Lewis' PhD students attended conferences worldwide to present their work at international conferences.
- One patent was applied for.

Autonomous Helicopters

Under funding from ARO we have started a new lab for control of autonomous unmanned vehicles (UAV). We bought three small helicopters which are being converted to UAV using circuits designed by PhD student Emanuel Stingu.

Undergraduate students Chris McMurrough and Matt Middleton are designing a system to convert small remote controlled helicopters into disposable short range UAV.

Plans are to design autopilots for autonomous maneuvers, landing, and formation control.



ARRI's fleet of UAV helicopters, including the all-terrain landing platform.

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 five 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.

US Patent Submitted

A US Patent was submitted under sponsorship of NSF and Army Research Office funding:

B. Borovic, F.L. Lewis, A.Q. Liu, and D. Popa, "Systems and Methods for Improved Control of Micro-Electrical-Mechanical System (MEMS) Electrostatic Actuator," UTSL 062US, The Univ. Texas at Arlington, April 2006.

Published

This year 11 journal papers and one book were published:

F.L. Lewis, L. Xie, and D. Popa, Optimal & Robust Estimation: With an Introduction to Stochastic Control Theory, John Wiley and Sons, New York, 2007. Second Edition.

We published 23 conference papers, which were presented internationally by Professor Lewis or his students.