Moncrief-O'Donnell Endowed Chair
2006 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 30 PhD students. Most of these students have won international and local awards for their work, and several have written books and received US patents.

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.

U.K. Inst. Measurement & Control

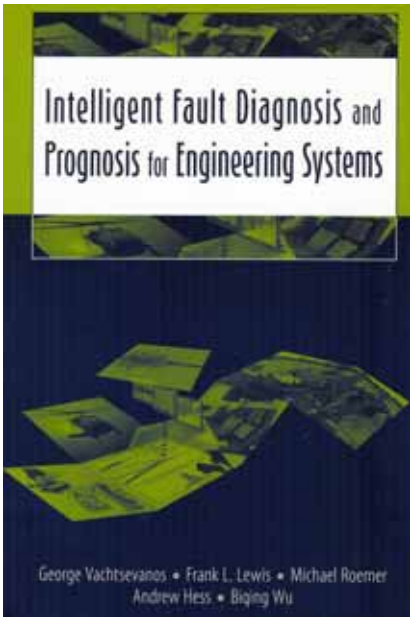
This year Dr. Lewis was elected a Fellow of the Royal Institute of Measurement & Control in London.

He was also elected as a Chartered Engineer of the U.K. Engineering Council, equivalent to the title of Professional Engineer in the US.

Four Books Published

This year 4 books were published:

- **M. Abu-Khalaf, J. Huang, and F.L. Lewis, Nonlinear H2/H-Infinity Constrained Feedback Control Using Neural Networks, Springer-Verlag, Berlin, 2006.**
- **G. Vachtsevanos, F.L. Lewis, M. Roemer, A. Hess, B. Wu, Intelligent Fault Diagnosis and Prognosis for Engineering Systems, John Wiley.**
- **S. Bogdan, F.L. Lewis, Z. Kovacic, and J. Mireles, Manufacturing Systems Control Design: A Matrix Based Approach, Springer-Verlag.**
- **S.S. Ge and F.L. Lewis, Autonomous Mobile Robots: Sensing, Control, Decision, and Applications, CRC Press.**



PhD Student Graduates

Three PhD students were graduated.

Murad Abu-Khalaf had his thesis published as a book and received the Outstanding Thesis Award.

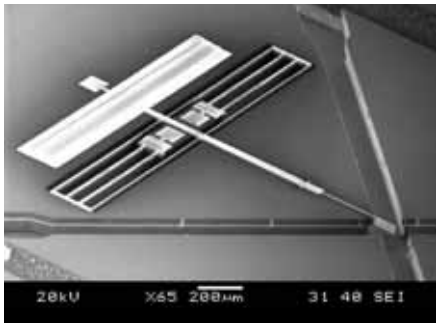
Bruno Borovic received the Outstanding Thesis Award and now works for Invensense Inc., a MEMS startup in California.

Vincenzo Giordano was invited to do PhD research in Singapore and now works in Rome, Italy.

MEMS Control

Micro-electro-mechanical systems are the next step in the silicon revolution which began in the 1960s and has changed all our lives. ACS has developed new techniques for the control of MEMS optical switches and micro actuators. Working with Ai Qun Liu at Nanyang Technological University in Singapore, Bruno Borovic has shown how to make MEMS devices faster and more precise. A US patent has been applied for:

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.



MEMS optical switch the size of a human hair

Keynote Speech Invitations

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

- Nan Chang Plenary Speaker at 85th anniversary of Xiamen University, China.
- Founding of International Systems & Controls Center, Xiamen University, China.
- Workshop on Sensor Networks, National University of Singapore.
- Intelligent machinery diagnostics, A-Star Institute for InfoCom Research, Singapore.

EDITORSHIPS

Dr. Lewis serves as:

- Editor, Taylor & Francis 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

- $500,000 in ongoing funding from National Science Foundation, the Army Research Office, and Texas ATP Program.
- Three PhD students and 3 MS students were graduated.
- Four books were published.
- Five journal papers, 3 book chapters, and 11 conference papers were published.
- Lewis was invited to deliver keynotes at international events.
- Organized the ARRI Distinguished Lecture Series to invite international scientists to UTA to increase its visibility.
- One patent was received and one applied for.
- Lewis was elected a Fellow of the UK Royal Istritute of Measurement & Control, and a Chartered Engineer of the UK Engineering Council.
- MS student Koushil Sreenath received the Best paper award at the IEEE Int. Conference on Robotics and Automation in Bangkok.
- Started a new lab- DIAL- for security, sensor networks, and autonomous vehicles.

Wireless Sensor Networks, Security, and Autonomous Vehicles

Working with ARRI's Dr. Dan Popa, we founded DIAL- the ARRI Distributed Intelligence & Autonomy Lab. The mandate is to develop deployable sensor networks and autonomous platforms- for air, land and sea- for monitoring and preserving security in designated coverage areas.

PhD student Emanuel Stingu (L) talks about his autonomous helicopter to Sankar Gorthi.

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.

US Patent Received

A US Patent was received under sponsorship of NSF and Army RO funding:

J. Campos and F.L. Lewis, "Method for Backlash Compensation Using Discrete-Time Neural Networks," U.S. Patent 7,080,055, awarded July 2006.

Best Paper Award at IEEE Conference on Robotics & Automation, Bangkok

Masters student Koushil Sreenath received the Best Paper Award at the IEEE Conference on Robotics, Automation, and Mechatronics in Bangkok for his paper

Localization of a wireless sensor network with unattended ground sensors and some mobile robots

coauthored with F. Lewis and D. Popa. Sreenath now works in the Intelligent Control Systems group of the Saint-Gobain R&D center in Northborough, Massachusetts.