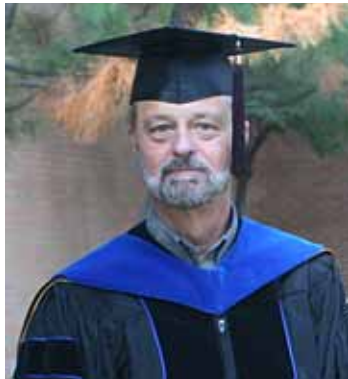


Moncrief-O'Donnell  
Endowed Chair  
2009 Annual Report



F. L. Lewis, Ph.D., Moncrief-O'Donnell Endowed Chair  
Fellow IEEE, Fellow IFAC  
Fellow U.K. Inst. Meas. & Control  
Prof. Engineer Texas, Chartered Eng. UK Eng. Council  
University Distinguished Scholar Professor  
The Automation and Robotics Research Institute  
The University of Texas at Arlington

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, 8 Ph.D. students, masters and undergraduate students, and 4 international visiting research faculty. The primary thrusts of ACS are research in controls design for robotic, aerospace, and autonomous systems, intelligent control, Wireless Sensor Networks, and real-time control implementation.

Lewis has graduated 35 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 \$7 million has been received from Texas State, the National Science Foundation, the US Air Force, and the Army Research Office to perform research and develop technology in Intelligent Control Systems, Industrial Control, and Vehicle Control Systems. 11 SBIR contracts have been received from DoD to work with small companies to transfer technology developed at ARRI.

### \$380,000 in New Funding Received

Three new grants were received this year:

**Air Force Office of Scientific Research AFOSR Grant** for 3 years for \$250,000 for research in trust establishment in networked man/machine teams, and how trust impacts distributed decision and control.

**DARPA SBIR Contract** for \$30,000 through SignalPro, Inc., to study reinforcement learning techniques in control of unmanned flying vehicles. We will use high-level learning methods to tune adaptive controllers to reject disturbances and uncertainty.

**NSF Graduate Research Supplement** for \$100,000 for support of US Citizen students in the PhD program at UTA. Matt Middleton and Chris McMurrough will work on networked autonomous systems.

### PhD Student Draguna Vrabie's Research Draws Invited Papers and Talks



Based on the doctoral research of Ms. Draguna Vrabie in reinforcement learning for feedback control, we have received invitations to publish papers and chapters, and for Dr. Lewis to deliver keynote speeches internationally. Ms Vrabie has discovered how to design adaptive controllers that learn from system performance, and yet converge to optimal control solutions such as used by natural and biological systems. She receives the PhD in December 2009.

- Invited Feature Article for IEEE Circuits & Systems Magazine, 2009.
- Invited Chapter for the Control Systems Handbook, 2009.
- Invited workshop on Neuro-Adaptive Control, Xiamen China, 2009.
- Keynote speech, ICIEA Conf. Singapore, 2008.
- Keynote speech, ICCSE Conf. Kaifeng, China 2009.
- Semi-Plenary speech, IEEE Conf. Decision & Control, Cancun, 2008.

### Trust and Control for Networked Teams

Under \$250K in new funding from US Air Force Office of Scientific Research AFOSR we have started research in trust establishment and propagation in networked teams of man/machine systems. We will examine how trust impacts decision and control in distributed systems with human and robot components. Our Distributed Intelligence & Autonomy Lab has been enhanced with new systems of robotic vehicles and human interfaces, and 3 new PhD students have been taken on.

### Work with Air Force and Army

**Chris McMurrough's** paper received the Multicore Graphical Design Achievement Award at NI Week, Austin, in August 2009 for his work at Wright Patterson Air Force Base with Dr. David Doman and Dr. Siva Banda.

**Matt Middleton** received \$100K in NSF funding for a PhD to work with Dr. Greg Hudas at US Army Tank Automotive Command for Technology Transfer on autonomous vehicle decision & control.

### Awards Received

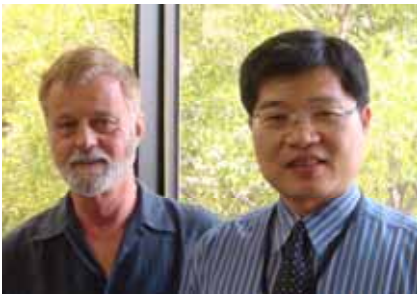
Lewis received the Honeywell Field Engineering Award from the U.K. Institute of Measurement and Control.

Lewis received the Gabor Award from the International Neural Network Society in June 2009 for his work over the years in advanced feedback control systems based on neural networks.

### IEEE Mediterranean Control Conference Thessaloniki, Greece June 2009

Lewis and Vassilis Petridis from Aristotle University organized the 17<sup>th</sup> MED conference this year. Lewis and colleagues Christodoulou, Ioannou, Valavanis, and Antsaklis founded the MED conference series, the first of which was held in Chania, Crete in 1993. MED has developed into a powerful forum for the exchange of research ideas in systems and controls in the Mediterranean/Europe Region.

### Former Student H.H. Huang Returns for Research



Dr. Hsiang-Hsi Huang received his PhD with ARRI Controls Group in 1995. His PhD dissertation won the Republic of China "National Science Council Research Award". He subsequently served as Chair of the Department of Industrial Management at National Pingtung University in Taiwan. Now he has returned to ARRI to do research with us for 1 year on dynamic manufacturing systems.

### PhD Student Patent and Textbooks

Three PhD students publish creative works based on their doctoral research.



**Dr. Bruno Borovic** received a US Patent "Methods for Improved Control of a Micro-Electrical-Mechanical System (MEMS) Electrostatic Actuator, US Patent 7,548,011, 16 June 2009.



**Dr. Prasanna Ballal** will publish the book "Wireless Sensor Networks" for National technology and Science Press, Austin.



**Koushil Sreenath** will publish a book on "Adaptive Sampling with Mobile Wireless Sensor networks" for Verlag VDM Press, Berlin.

### DFW LOCAL IMPACT

#### Leadership in the Local Scientific Community

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 IEEE best chapter award in 1994. He was selected as Fort Worth Engineer of the Year by the IEEE Section in 1995. We have received significant funding from NSF, AFOSR, 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 Patents and US Industry

Six US Patents have been received by ARRI's Advanced Controls and Sensors group on technology developed for intelligent control of nonlinear industrial, vehicular, and aerospace systems.

11 Department of Defense SBIR Contracts have been received to transfer technology to local and national small businesses. ARRI won the SBA Tibbets Award in 1996 for its work with small companies.

#### 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

#### Arlington ISD 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 Melissa Grubb at the Oakridge School to run a summer high school outreach program.