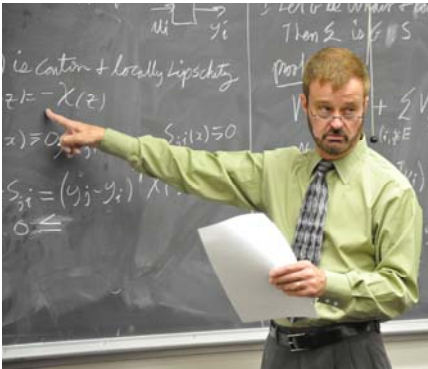


Moncrief-O'Donnell
Endowed Chair
2010 Annual Report



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 often international visiting research faculty. The primary thrusts of ACS are research in controls design for robotic, aerospace, and autonomous systems, intelligent control, cooperative control of networked teams, sensor networks, and real-time control implementation.

Lewis has graduated 38 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 and one is a Dept. of Homeland Security Career Awardee.

Dept of Homeland Security Career Award

Dr. Jyotirmay Gadewadikar, PhD UTA, 2007 has won the Department of Homeland Security Early Career Faculty Leadership Award.



Funding Received From NSF, Army, Air Force, DARPA, DoE

ACS has current funding from five government agencies.

National Science Foundation (NSF) Grant. \$250,000, 2008-2011, for development of control systems for nonlinear systems and networked multiplayer teams.

US Army Research Office (ARO) Grant. \$360,000, 2005-2011, for Decision and Control in networked teams of humans and autonomous robots.

Air Force Office of Scientific Research (AFOSR) Grant. \$250,000, 2009-2012, for research in trust establishment in networked man/ machine teams, and how trust impacts distributed decision and control.

DARPA SBIR Contract. \$30,000, 2010, 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.

Department of Energy (DoE) SBIR II Contract for \$210,000, 2007-2011, with Dr. Weijen Lee, EE Dept for developing a wireless sensor network for monitoring and fault detection in rotating electrical machinery.

3 PhD Students Graduate

This year 3 PhD students graduated from ARRI ACS. Two have taken jobs in US Industry.



Dr. Draguna Vrabie now works at United Technologies Research Center, Hartford CT.



Dr. Abhijit Das works at Caterpillar Technical Center, Mossville Illinois.



Dr. Hongwei Zhang was the student of Dr. Jie Huang at Chinese Univ. Hong Kong. He spent his last year on PhD research at ARRI. He now works as a Visiting Researcher at ARRI.

Draguna Vrabie Wins Best Paper Award

Dr. Draguna Vrabie received the Best Paper Award at the International Joint Conference on Neural Networks, Barcelona in July for her paper

“Adaptive Dynamic Programming Algorithm for Finding Online the Equilibrium Solution of the Two-Player Zero-Sum Differential Game”

Awards Received

Lewis received these awards this year:

UTA Graduate Dean's Excellence in Doctoral Mentoring Award.

IEEE Region 5 Outstanding Engineering Educator Award.

Visiting Research Fellow, Singapore Manufacturing Technology Institute.

Benjamin Meaker Fellow, Bristol University, England.

International Invited Lectures and Workshops

Lewis was invited to deliver Plenary Talks and Workshops internationally:

Asian Control Conference ASCC, Hong Kong, Aug. 2009.

Chinese Academy of Sciences, Beijing, May, 2010.

IFAC Workshop on Adaptation and Learning in Control, Antalya, Turkey, August 2010.

B. Meaker Lecture, Bristol University, England.

Singapore Manufacturing Technology Institute, June 2010.

World Congress on Intelligent Control and Automation WCICA, Jinan, 6-9 July 2010.



Research Directions and Publications

The topics looked at this year include:

Decision-making in networked teams of distributed players, including both cooperative control and non-cooperative control. Applications have been to military teams and coordination of multiple vehicle systems.

Online solution of differential games for multiple players by looking at their responses to applied stimuli. Concepts of Reinforcement Learning were developed for real-time control of dynamical systems.

Control of systems linked by communication graphs. How does the communication structure influence the decisions made by cooperative dynamical systems? How can better communication structures be designed?

This year we have published eleven journal papers and our students attended conferences to present their results.

A new course was developed in the UTA Electrical Engineering Department- EE 5329 Distributed Decision and Control.

Arlington ISD and High School Student Summer Outreach Program

We run a summer program at ARRI where top high school students are invited to work in robotics and control for 2 weeks. These students work with UTA students on projects in the ACS laboratory.

Solution of Dynamic Games

PhD student K. Vamvoudakis has discovered how to solve Multi-Player Games in real-time by observing the motions and decisions of other players. He has made applications to cooperative teams of networked systems for military applications and elsewhere.



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. He received the IEEE Region 5 Outstanding Engineering Educator Award in 2010.

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.