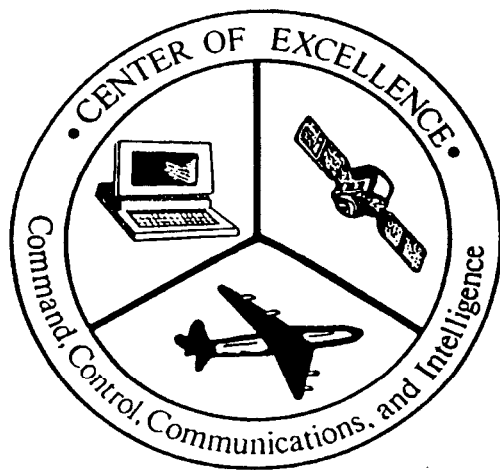


COMP-00019



*The Center of Excellence
in
Command, Control,
Communications, and Intelligence*

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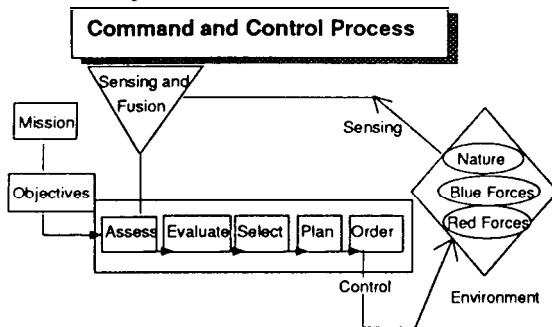
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The Research Program

The research program is structured around the command and control process. A simplified view of the process for a military system is shown below. Similar models apply to various civilian systems. The process involves production of data from sensor systems, processing the data and transforming it into information, processing information for decision making, and dissemination of data, orders, information, and control through communication systems. The Center research program is designed in such a way that investigators explore all aspects of this process, as well as the total process.

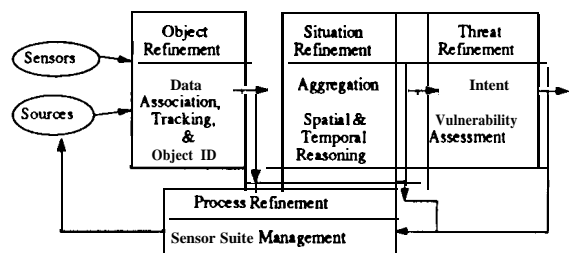


Sensing and Fusion

Sensor systems are used in the C³I process in two ways—sampling the environment for data and for feedback regarding actions that have been taken to affect the environment. Fusion systems track and identify objects, combine objects into a situation map, project threat actions into the future, and manage fusion resources. Specific current projects in this area include: multi-target, multi-sensor tracking using neural-networks; infrared image background analysis and **characterization** using fractals; quadratic detection algorithms; millimeter wave radiometric imaging; development of a modular fusion **testbed**; neural network adaptive controller for **UAV's**; and data fusion employing Bayesian Networks. The Sensing and Fusion group receives direct contract support from the US

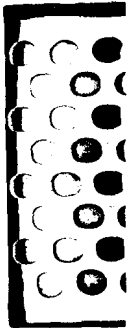
Army Signals Warfare Directorate, the US Arms Control and Disarmament Agency, Advanced Research Project Agency (ARPA), Air Force Office of Scientific Research (AFOSR), US Air Force Rome Laboratory, and is a subcontractor to **SAIC, Inc.**, Grumman Melbourne Systems, and **Thomson-CSF**. The area coordinator for the Sensing and Fusion Group is Dr. Dennis Buede. Faculty working in the area include Drs. Kathryn Laskey, K. C. **Chang**, Kenneth Hintz, Oluseyi Olurotimi, and Mr. Victor Larson.

Sensing & Fusion Process Model



Command Support

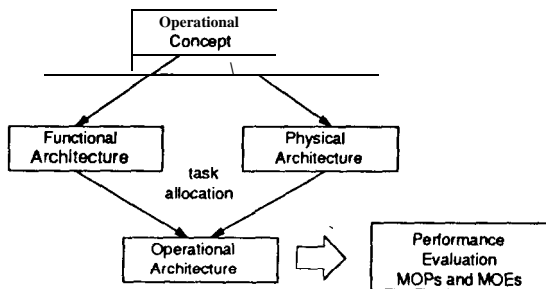
The Command Support area focuses on the activities of the commander and his staff and on various systems to support their actions. Research in this area is oriented towards aiding the human decision maker through automation of many of the processing functions such as planning and resource allocation as well as improved man machine interfaces. Specific research projects in this area address requirements analysis, design, development, testing and evaluation of tactical decision aids and group decision support systems; automated adversarial planning; and dynamic situation assessment. The Command Support group has received recent support from the US Army Research Institute, the Office of Naval Research, and is a subcontractor to Evidence Based Research, Inc. Area coordinators for Command Support are Drs. Leonard Adelman and Paul **Lehner**. Faculty working in this area include Ms. Lee **Ehrhart**.



Architectures

The focus of the C^3 Architectures area is the development and use of analytical systems engineering methods for the analysis and synthesis of C^3 architectures and systems. Current projects under the auspices of the C^3 Architectures research program include: Colored Petri Net representation of variable structure architectures; evaluation of functionality in C^3 architectures; coordination in distributed decision making organizations; analysis of the C^2 element of the National Missile Defense System; and modeling of concepts of operation. The C^3 Architectures group is supported by the Office of Naval Research and the US Army Operations Test and Evaluation Command (OPTEC) and is a subcontractor to SAIC, Inc. Dr. Alexander Levis, who has worked in Petri Nets for over **20 years**, is the area coordinator for the C^3 Architectures group. Faculty working in this area are Messrs. Didier Perdu and Lee Wagenhals.

Architecture Design Process



Communications & Signal Processing

Communications play an essential role in C^3 I systems. The C^3 I Center research activities in the communications area focus on both the network and link aspects of the problem. Specific active research projects include: optimum resource allocation for TDMA/FDMA/SDMA satellite systems; network management; architectures and protocols for high speed



packet networks; system design via importance sampling; and algorithms for adaptive arrays. The Communications group receives support from the National Science Foundation, the Defense Information Systems Agency, and the US Air Force Rome Laboratory. Dr. Harry L. Van Trees is the area coordinator for Communications. Faculty working in this area include Drs. **Yariv** Ephraim, Bijan **Jabbari**, Geoffrey Orsak, B. Peter Paris, Yosef Steinberg, and Ms. **Kristine** Bell.

Modeling and Simulation

The modeling and simulation area is continually growing in importance as systems become more complex and costly. Before buying such systems or deciding among competing alternatives, extensive cost-benefit and operational utility analyses are necessary. Distributed interactive simulation is becoming a major training resource. Current research projects focus on distributed simulations. The Modeling and Simulation group is performing work for the Defense Information Systems Agency and has received recent support from Argonne National Laboratory and the Joint Staff. Dr. Mark **Pullen** is the area coordinator.

Information Systems Architectures

The Information Systems Architecture area conducts research in advanced information system networks and applications implemented over hybrid wide area-local area networks. Research and development is conducted in a laboratory equipped with a range of microcomputers, local area networks, and ISDN networking equipment. Current research includes: Broadband and Narrowband **ISDN**, Asynchronous Transmission Mode networks, client server applications development, group work and group decision support systems over wide area networks, and document imaging systems. The area coordinator is Mr. E. Paul Hager.

Rationale

Command, Control, Communications, and Intelligence (C³I) systems are essential to our national security. History provides many examples of how C³I has influenced the outcome of an engagement or an entire conflict. In spite of its importance there is not an adequate intellectual base for the C³I area, and comprehensive educational programs in C³I do not exist. The Center of Excellence in C³I at George Mason University is designed to fill these needs.

Organization

The Center of Excellence in Command, Control, Communications, and Intelligence at George Mason University was established under the direction of Dr. Harry Van Trees in July 1989 in order to provide an intellectual base for the command, control, communications, and intelligence area. The Center conducts a broad spectrum R&D and educational program in C³I. The program is accomplished by bringing together a multidisciplinary group consisting of academic faculty, research staff, and fellows in residence from industry and government.

Research program personnel include 35 faculty members from the School of Information Technology and Engineering (SITE), 8 research faculty members, 9 government and industry visiting research fellows, 30 graduate research assistants, and 25 thesis students.

Objectives

The Center has five main objectives:

- Conduct a broad spectrum multidisciplinary research and development program in C³I;
- Develop an intellectual base for C³I;
- Provide a comprehensive C³I curriculum that leads to a certificate in C³I or an M. Sc. in C³I;
- Act as a focus for doctoral research in C³I; and
- Provide technical support to industry and government in the C³I area.

George Mason University

George Mason University emerged in the 1980's as a major university in Virginia and the nation. Its development has been shaped in response to the educational needs of an extraordinary cosmopolitan constituency. By emphasizing information technology, public policy, and the **fine** and performing arts, the university has formed links with the community by meeting its needs while at the same time taking advantage of the best it has to offer in people and resources.

George Mason University's innovative programs and visionary outlook have attracted a faculty of world renowned scholars and teachers. Present enrollment is nearly 19,000 students studying in nearly 100 degree programs at the undergraduate, master's, doctoral, and professional levels.

Academic Programs

The C³I Center is part of the School of Information Technology and Engineering (SITE) at George Mason University. Located in the high technology area of Northern Virginia, the school is ideally positioned to take advantage of industrial, government, and academic interaction. This enables the academic and research programs to maintain a basis in real world issues and increases employment opportunities for graduates. SITE offers a single Ph.D. program in Information Technology spanning the disciplines of electrical and computer engineering, systems engineering, operations research and statistics, computer science, and information systems. At the **M.Sc.** level, a student can earn a Certificate in C³I in combination with either a **M.Sc.** in Electrical or Systems Engineering. Alternatively, a student can earn a **M.Sc.** in C³I Systems Engineering. In each instance the student does a thesis or master's project in a C³I Center research laboratory. These programs are unique; George Mason University is the only civilian university offering a quantitative master's degree in C³I.

Funding Support

The C³I Center receives financial support in two manners - general sponsorship and specific research contracts. General sponsorship consists of an unrestricted grant to the research center and is used to provide seed money for new research initiatives in an area of interest to the sponsor and to support the infrastructure of the center. The C³I Center receives general sponsorship support from the Virginia Center for Innovative Technology, TRW. ASD (C³I), Defense Information Systems Agency (DISA), US Army CECOM, and US Air Force Rome Laboratory. In addition, the Center is currently performing on approximately 40 research contracts requiring specific deliverables. These contracts are often an outgrowth of research work that began under the general sponsorship program.

Diversification Beyond Military Applications

C³I technologies have important uses in civilian areas as well as the traditional military applications. C³I Center faculty are performing research on noisy speech reduction for hearing aids. In collaboration with Research Development Corporation, a Virginia small business, the C³I Center is developing a **computer**-based educational game that utilizes artificial intelligence technology to teach statistics to junior high school students.

Assistance to Industry

The C³I Center provides technical support to large and small businesses in the C³I area. The C³I Center has performed work as a subcontractor for SAIC, PRC, CALSPAN, GTE, IITRI, TASC, and other large businesses. The C³I Center also runs an active small business program contributing technical expertise and limited matching funds to enhance the capabilities of small businesses. The Center runs a monthly evening seminar program where technical experts from the Government and industry gather and discuss research activities.