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Professor Borges' research was in two areas. First, the application of Markov Random Field models of texture to a variety of image processing problems. The main thrust of his work this year was on developing a practical set of computer algorithms to use as a toolbox in future investigations. Some additional studies of the appropriateness of MRF techniques for both image segmentation and target detection were also carried out. Professor Borges other main thrust concerned the development of fast and numerically stable algorithms for fitting polynomial splines to ordered data with minimal error in the total least-squares sense.

Professor Danielson's research is also in two areas. First, a collaborative effort with Professor Canright in to analyze the current version of NAVSPACECOM's AUTODC program for satellite orbits. The current code has flaws and is undocumented, precluding improvement. The investigators began their analysis and the development of complete documentation describing the mathematical algorithms and software structure of AUTODC.

Professor Danielson is also involved in collaborative effort in support of the ongoing development of the Army's RAH-66 Comanche helicopter. Research for 1998 comprised two parts: For the first part, developmental flight testing of the Comanche helicopter had revealed high vibrations caused by buffeting of the aircraft empennage. From the flight test aircraft differential pressure transducer and accelerometer data, the spectral content of the response was determined. Then, using a NASTRAN model of the aircraft, the frequency response functions between selected points on the aircraft's tail and the flight test accelerometer locations were calculated. Finally, various assumptions as to the location and distribution of empennage air loads were made, and the magnitude of these airloads, and the relative importance of primary airframe modal responses to these airloads, were determined. Efforts for the second half of 1998 were directed to a new area, that of designing the tailboom to withstand the high pressure blast emitted from a 23 mm HEI (High Explosive plus Incendiary) round.

Professor Franke was involved in several efforts. First was developing methods for approximating the vertical covariance function for temperature and moisture. Using a four-month history (March-June 1998) from NOGAPS the spatial covariance of the innovation data from temperature and relative humidity (respectively) were fit using eight different approximation schemes. Based on the results, two were chosen to use for extended investigations.

Professor Franke was also collaborated with Professors Neta and Clynch in an investigation of error in GPS positions. The error in GPS positions consists of two primary parts, a random error assumed to have a Gaussian distribution, and a slowly varying bias dependent upon the satellites from which the GPS receiver obtains its data and their configuration. The latter changes abruptly when a different configuration of satellites is used. The objective of this investigation is to devise techniques for estimating the two errors by using multiple trajectories obtained with GPS receivers in the Precise Position System along roads and then obtain an average trajectory.

Professor Fahroo was involved in several efforts as well. First, applying the theory of periodic optimal control to the problem of orbit control of low-Earth-orbiting (LEO) spacecraft and satellites, with the goal of finding optimal maneuvers that result in minimum fuel consumption. Her second project focused on determining the optimal location of controllers to achieve reduction of a noise field in an acoustic cavity. Finally, she continued her ongoing efforts to study the exponential stability of several acoustic-structure models by numerical approximation of the models.

Professor Gragg's research focused on implementing, rigorously testing, and proving numerical stability of new stable algorithms for executing the second phase of Pisarenko's signal processing algorithm, now reformulated so as to solve a well-conditioned problem. The new algorithms, stabilized forms of the unitary Hessenberg QR (uhqr) algorithm, permit fast, $O(n^2)$, solution of problems of (essentially) arbitrarily high order. Together, these algorithms provide algorithms for fast adaptive recursive least squares modeling of stationary time series by trigonometric polynomials (spectral estimation).

Professor Jayachandran continued his work on developing a statistical methodology for performing a sensitivity analysis of the project cost estimates produced by PACE, a computerized cost estimating model developed for the U.S. Coast Guard.

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Professor Kang continued his work on bifurcations of control systems with uncontrollable dynamics. This year he developed a feedback design for the control of bifurcations with co-dimension one, and obtained the normal forms of systems with two uncontrollable modes are obtained. He also completed the design and simulations for the Moore-Greitzer model of engine compressors. This work has generated a great deal of very significant output.

Professor Mansager conducted ACQ 201 classes at Edwards AFB, CA; Philadelphia, PA; Jacksonville NAS, FL; Phoenix, AZ; and conducted a TST 301 at Warren, MI.

In addition to his joint work with Professor Franke mentioned above, Professor Neta was involved in several other research projects. First was an investigation of the possibility of a control decomposition approach to parallelize a numerical orbit. He was also involved in a collaboration with F.X. Giraldo wherein they analyzed the stability of the finite element approximation to the linearized two-dimensional advection-diffusion equation. Bilinear basis functions on rectangular elements are considered. Giraldo and Neta have previously numerically compared the Eulerian and semi-Lagrangian finite element approximation to the advection-diffusion equation. This work analyzes the finite element schemes used there.

Professor Rasmussen's work was in two main areas. First, an effort to develop and evaluate heuristics for finding approximate solutions to hard combinatorial optimization problems, such as graph coloring, that arise in diverse problems such as scheduling and frequency assignment. The focus in the past year was an improved implementation of an algorithm for approximating the chromatic number of a graph. Ada-95 code has now been developed, and tested, for a variety of key tasks (e.g., constructively determining the chromatic number of a chordal graph). His second research focus was the continuation of a collaborative project characterize competition graphs and p-competition graphs of various highly structured families of graphs and digraphs.