1999

Advanced Avionics Technology
PI: I. I. Kaminer, Associate Professor
Sponsor: NAVAIR - 4.5T

OBJECTIVE: To perform research and development in advanced avionics technology topics relevant to NAVAIR MAST program

SUMMARY: Over past several years under NAVAIR sponsorship NPS has embarked on the development and evaluation of rapid flight test prototyping system for unmanned air vehicles (UAV's). During 1999 we have completed the development of this system.

Closed-Loop Pitch Control Effector Sizing
PI: I. I. Kaminer, Associate Professor
Sponsor: NASA Langley

SUMMARY: This project developed a new optimization tool for obtaining the closed loop tail sizing criteria for HSCT. Final presentations were given at Boeing Long Beach in February of 1999 and at NASA Langley in May of 1999.

Passive Sensor-Based Control of Nonlinear Autonomous Systems
PI: I. I. Kaminer,
Sponsor: ONR

SUMMARY: The objective of this proposal is to investigate sensor fusion architectures and mathematical algorithms required to support autonomous vertical take off and landing (VTOL) of uninhabited combat air vehicles on ships using passive sensors. Preliminary results were obtained on the synthesis of time-varying and nonlinear filters that integrate vision, GPS and inertial sensors to provide an accurate estimate of ship's position with respect to the aircraft as well as of the ship's inertial velocity.

FY-98 Engineering and Technical Support for UAV JPO Phase II Contract Effort
PI: I. I. Kaminer
Sponsor: NAVAIR

SUMMARY: Provide engineering and technical support to UAV JPO in managing the Phase II of the SBIR proposal "Low-Cost Fault Tolerant Controls for Unmanned Air Vehicles". The project was kicked off at NPS in November of 1997.

1998

ADVANCED AVIONICS TECHNOLOGY
I.I. Kaminer, Assistant Professor
Sponsor: NAVAIR-4.5T

OBJECTIVE: To perform research and development in advanced avionics technology topics relevant to NAVAIR MAST program.

SUMMARY: Over past several years under NAVAIR sponsorship NPS has embarked on the development and evaluation of rapid flight test prototyping system for unmanned air vehicles (UAV's). During 1998 a voice control system was developed and flight tested as well as a new flight management system for autonomous UAV flight.

JSOW Unitary Captive Air training Missile 9CATM) Conceptual Design
I.I. Kaminer, Assistant Professor
Sponsor: NAVAIR PMA-201

OBJECTIVE: To perform conceptual design studies on a captive air training missile for the JSOW Unitary Missile explore the possibility of extending its applicability to other missiles.

SUMMARY: On this project I was responsible for the issues related to the JSOW CATM avionics system and for the development of cockpit steering commands requirements for the carriage aircraft. The work accomplished includes development of the preliminary functional requirements for JSOW CATM avionics a well as development of JSOW 6DOF nonlinear simulation and guidance and control system for a typical JSOW profile.

CLOSED-LOOP PITCH CONTROL EFFECTOR SIZING
I.I. Kaminer, Assistant Professor
Sponsor: NASA Langley

SUMMARY: This project developed a new optimization tool for obtaining the closed loop tail sizing criteria for HSCT. In particular, the tool is capable of determining the maximum cg travel for a given HSCT tail volume subject to a variety of disturbance recovery and closed loop constraints as well as structural mode considerations. The disturbances considered included vertical gust and sinusoidal inputs. The closed loop constraints included the effect of feedback specifications, such as MIL STD 1797 Level I and II flying qualities requirements. Furthermore, the HSCT actuator amplitude and rate constraints were accounted for. Moreover, the tool has the option of including the structural mode considerations.

PASSIVE SENSOR-BASED CONTROL OF NONLINEAR AUTONOMOUS SYSTEMS

I.I. Kaminer, and R.W. Duren

Sponsor: ONR

SUMMARY: The objective of this proposal is to investigate sensor fusion architectures and mathematical algorithms required to support autonomous vertical take off and landing (VTOL) of uninhabited combat air vehicles on ships using passive sensors. Preliminary results were obtained on the synthesis of time-varying and nonlinear filters that integrate vision, GPS and inertial sensors to provide an accurate estimate of ship's position with respect to the aircraft as well as of the ship's inertial velocity.

FY-98 ENGINEERING AND TECHNICAL SUPPORT FOR UAV JPO PHASE II CONTRACT EFFORT

I.I. Kaminer, and R.W. Duren

Sponsor: NAVAIR

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1997

JSOW UNITARY CAPTIVE AIR TRAINING MISSILE (CATM) CONCEPTUAL DESIGN

I.I. Kaminer, Assistant Professor
Sponsor: NAVAIR PMA-201

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FY-98 ENGINEERING AND TECHNICAL SUPPORT FOR UAV JPO PHASE II CONTRACT EFFORT

I.I. Kaminer

Sponsro: UAV JPO

SUMMARY: Provide engineering and technical support to UAV JPO in managing the Phase II of the SBIR proposal "Low-Cost Fault Tolerant Controls for Unmanned Air vehicles". The project was kicked off at NPS in November 1997.

1996

ON INTEGRATED AIRCRAFT/CONTROLLER DESIGN FOR AUTONOMOUS AIR AND UNDERWATER VEHICLES

I.I. Kaminer, Assistant Professor
Sponsor: NPS

OBJECTIVE: The objective of this proposal is to develop a new methodology for integrated aircraft/controller design.

SUMMARY: The methodology developed under this proposal provides aircraft systems designer with a new tool capable of solving the following problem: Given the flying qualities requirements for a specified mission, find the minimum control surface sizes and a feedback controller which together satisfy these requirements. The key approach is to rewrite the flying qualities requirements as Linear Matrix Inequalities.

MARITIME AVIONICS SUBSYSTEMS AND TECHNOLOGY PROGRAM (MAST)

I.I. Kaminer, Assistant Professor
Sponsor: NAVAIR

OBJECTIVE: To perform research and development in advanced avionics technology topics relevant to NAVAIR MAST program

SUMMARY: Over past several years under NAVAIR sponsorship NPS has embarked on the development and evaluation of GPS/INS integration systems. In particular, we have made progress in the development of the uniform framework for the INS/GPS integration using Kalman Filtering. The work is ongoing and strives to unify various approaches to the development of INS systems and their integration with GPS using Kalman Filtering.

JSOW UNITARY CAPTIVE AIR TRAINING MISSILE (CATM) CONCEPTUAL DESIGN

I.I. Kaminer, Assistant Professor
Sponsor: NAVAIR

OBJECTIVE: To perform conceptual design studies on a captive air training missile for the JSOW Unitary Missile explore the possibility of extending its applicability to other missiles.

SUMMARY: On this project I was responsible for the issues related to the JSOW CATM avionics system and for the development of cockpit steering commands requirements for the carriage aircraft. The work accomplished includes development of the preliminary functional requirements for JSOW CATM avionics as well as development of JSOW 6DOF nonlinear simulation and guidance and control system for a typical JSOW profile.

1995

ON DESIGN AND IMPLEMENTATION OF NONLINEAR GAIN-SCHEDULED CONTROLLERS FOR MANNED AND UNMANNED VEHICLES

I.I. Kaminer, Assistant Professor

SPONSORS: NPS and 1994-1995 NATO FELLOWSHIP

OBJECTIVE: The goal of this project is to develop efficient techniques for designing and implementing gain-scheduled controllers for nonlinear plants. In particular, we are interested in the designing of trajectory tracking controllers for autonomous underwater and air vehicles.

SUMMARY: The work covered by this proposal addresses the problem of integrated design of guidance and control systems for autonomous vehicles (A Vs). In fact, we have developed a new methodology for integrated design of guidance and control for autonomous vehicles. The methodology proposed leads to an efficient procedure for the design of controllers for A Vs to accurately track reference trajectories defined in an inertial reference frame. This methodology was applied to the design of a tracking controller for the Unmanned Air Vehicle Bluebird at the NPS UAV Lab and to the Autonomous Underwater Vehicle Marius at the Instituto Superior Tecnico of Lisbon, Portugal.

MARITIME AVIONICS SUBSYSTEMS AND TECHNOLOGY PROGRAM (MAST)

I.I. Kaminer, Assistant Professor

Sponsor: NAVAIR

OBJECTIVE: To perform research and development in advanced avionics technology topics relevant to NAVAIR MAST program

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ON DEVELOPMENT OF HSCT TAIL SIZING CRITERIA

I.I. Kaminer, Assistant Professor

Sponsor: NASA Langley Research Center

OBJECTIVE: To Develop Tail Sizing Criteria for High Speed Civil Transport

SUMMARY: This work was done as a part of NASA/ASEE Summer Faculty Fellowship Program. It determined the HSCT tail sizing criteria using newly developed integrated aircraft/controller design methodology (the methodology was developed together with my Ph.D. student R. Niewoehner). The key idea was to rewrite the tail sizing and feedback requirements as Linear Matrix Inequalities. In particular, the effects of feedback specifications, such as MIL STD 1797 Level I and II flying qualities requirements, and of actuator amplitude and rate constraints on the maximum allowable cg travel for a given set of tail sizes were considered. A static state feedback controller was designed as a part of the tail sizing process.

LETHAL UNMANNED AIR VEHICLE FEASIBILITY STUDY

I.I. Kaminer, Assistant Professor

Sponsor: Unfunded

OBJECTIVE: Investigate the feasibility of using Unmanned Air Vehicles to detect and destroy mobile missile launchers.

SUMMARY: In the recent study conducted by Professor Marshal of Operations Research Department at NPS, the authors have shown that the most effective way to deal with ballistic missiles (like the SCUDS used by Iraq in the Gulf War) is to destroy the mobile missile launchers before the missile is launched. Motivated by these results we have developed a SIMULINK/MATLAB simulation to study the technical issues involved in using UAVs to accomplish this task. Furthermore, we conducted a survey of existing UAV systems to identify a platform most suitable to detect and destroy mobile missile launchers.

1994

APPLICATION OF H_∞ AND MIXED H_∞ two/H_∞ SYNTHESIS TO THE DESIGN OF ROBUT TRACKING CONTROLLERS AND RELATELD THEORY

I.I. Kaminer, Assistant Professor
Department of Aeronautics and Astronautics
Sponsor: NPS

OBJECTIVE: The ongoing goal of this project is to investigate the application of H_∞ and mixed H_∞^2/H_∞ synthesis techniques to the design of robust tracking controllers. Furthermore, should there be a lack of theoretical tools needed to accomplish this task, such tools will be developed.

SUMMARY: In the work covered by this proposal we addressed certain issues which are important to the design of control systems for combat aircraft. In particular, we applied recently developed robust control design methodologies to synthesize an automatic carrier landing controller for F—14. In general such controllers are designed for linear models of the plant around a number of nominal operating conditions. It turns out that for a certain class of nonlinear plants such designs result in gain-scheduled controllers. The issue of properly implementing such controllers has received little attention in the literature. Therefore, we are in the process of developing a methodology to properly design and implement gain-scheduled controllers on the nonlinear plants with applications to motion control of rigid bodies. Furthermore, we have developed a new methodology for the integrated aircraft control power/feedback controller desig. The main approach is to rewrite the performance requirements as Linear Matrix Inequalities. Finally, a significant effort was dedicated to the development of therapid prototyping system for flight control law analysis and hardware-in-the-loop testing for Unmanned Air Vehicles.

1993

APPLICATION OF H_INFINITY AND MIXED H_O/H _INFINITY SYNTHESIS TO THE DESIGN OF ROBUST TRACKING CONTROLLERS AND RELATED THEORY

I.I. Kaminer, Assistant Professor
Department of Aeronautics and Astronautics
Sponsor: Naval Postgraduate School

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ADVANCED AVIONICS TECHNOLOGY

I.I. Kaminer, Assistant Professor
Department of Aeronautics and Astronautics
Sponsor: Naval Air Systems Command AIR546TD

OBJECTIVE: To perform research and development in advanced avionics technology topics.

SUMMARY: In the work covered by this project we addressed certain issues which are important for the design of avionics systems for air vehicles. In particular, we investigated the applicability of various sensor and actuator failure detection and isolation techniques (FDI) to the failure detection and isolation problem in a close range aircraft. Next, we developed a differential GPS/INS navigation system to be used by the aircraft waypoint guidance system. Finally, in order to facilitate proper development and testing of the above systems we developed a high fidelity six degree of freedom nonlinear model of the close range aircraft and built a real-time hardware-in-the-loop simulation station.