AERONAUTICAL AND ASTRONAUTICAL ENGINEER

VISION-BASED NAVIGATION FOR AUTONOMOUS LANDING OF UNMANNED AERIAL VEHICLES

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The role of Unmanned Aerial Vehicles (UAVs) for modern military operations is expected to expand in the 21st Century, including increased deployment of UAVs from Navy ships at sea. Autonomous operation of UAVs from ships at sea requires the UAV to land on a moving ship using only passive sensors installed in the UAV. This thesis investigates the feasibility of using passive vision sensors installed in the UAV to estimate the UAV position relative to the moving platform. A navigation algorithm based on photogrammetry and perspective estimation is presented for numerically determining the relative position and orientation of an aircraft with respect to a ship that possesses three visibly significant points with known separation distances. Original image processing algorithms that reliably locate visually significant features in monochrome images are developed. Monochrome video imagery collected during flight test with an infrared video camera mounted in the nose of a UAV during actual landing approaches is presented. The navigation and image processing algorithms are combined to reduce the flight test images into vehicle position estimates. These position estimates are compared to truth data to demonstrate the feasibility of passive, vision-based sensors for aircraft navigation. Conclusions are drawn, and recommendations for further study are presented.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Computing and Software, Sensors

KEYWORDS: Unmanned Aerial Vehicle, Navigation, Infrared Imaging, Image Processing, MATLAB®, Simulation

EXPLORATION OF FIBRE CHANNEL AS AN AVIONICS INTERCONNECT FOR THE 21ST CENTURY MILITARY AIRCRAFT

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Avionics architectures are evolving from “Federated” systems consisting of highly specialized black boxes connected together via MIL-STD-1553 and ARINC 429 data buses to “Integrated” and “Distributed” architectures. These new architectures contain high data-rate sensors, parallel processors, and shared memory with high levels of integration. These systems require a new interconnection system that overcomes the limitations of older standards. One such interconnection system is Fibre Channel. This thesis evaluates Fibre Channel as avionics interconnection standard. It begins by defining the requirements and measures of performance for an interconnection system suitable for the new avionics architectures. The requirements address technical performance, affordability, reliability, sustainability, and

maintainability considerations. The Fibre Channel standards are then compared to the requirements for the avionics interconnection system. In order to perform a technical performance evaluation of a switched fabric avionics interconnection system, a computer simulation model was developed. The OPNET Modeler® tool from OPNET, Inc. was used to model the components of an advanced avionics system. The results of this simulation demonstrated that Fibre Channel meets all the performance requirements of an avionics interconnect.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Computing and Software, Electronics, Modeling and Simulation

KEYWORDS: Fibre Channel, Interconnect, Avionics, Bandwidth, Modeling, Simulation