**RESEARCH PROBLEM STATEMENT #RW-502**

**I – Problem Title**

Develop airborne GPS/INS calibration specifications and procedures for contracted services.

**II – Research Problem Statement**

Integrated GPS/INS systems are increasingly being used with modern digital aerial cameras and other automated terrain mapping systems. These sensors are available in the market with different capabilities. Standard procedures and specifications for the calibration of such integrated GPS/INS systems are required to operate such sensors for Caltrans mapping projects.

**III – Objective**

To develop standard calibration procedures and specifications for the use of safer and more productive airborne terrain mapping methodologies in Caltrans, while assuring the collection of consistent data quality. This study supports the Department's goal of performance by increasing the efficiency of data acquisition for planning and design.

**IV – Background**

Digital aerial cameras and airborne terrain mapping systems such as LIDAR have recently emerged as safer, rapid and highly productive technologies. All such airborne mapping systems rely on airborne integrated GPS/INS systems to establish the position and the attitude of the mapping sensor. This totally eliminates the need for field-surveyed control in support of terrain mapping. However, the GPS/INS system must be accurately calibrated in order to assure that data of reliable and consistent quality is obtained. Standard procedures and specifications for such calibration are essential before these technologies can be used by Caltrans.

**V – Statement of Urgency and Benefits**

The need for the research is urgent since the earliest introduction of airborne automated mapping technologies in Caltrans will greatly reduce the need for field survey, with consequent increase in the safety of field personnel. Such technologies will also enhance productivity and have the potential to increase the response time for mapping projects.

**VI – Related Research**

The procedures for the calibration of INS systems in a laboratory are available. Also the use of airborne GPS for mapping has been successfully researched by Caltrans and documented. However, comprehensive investigation of the calibration procedures for airborne GPS/INS integrated systems is still lacking. Some related publications are:


* Appleton, J, Hussain, M. and Munjy R (2000): Strategy for Use of Airborne GPS Data for Corridor Mapping, ISPRS, Amsterdam, Holland.

* Cramer, M., Stallmann, D. and Haala, N. (2000): Direct georeferencing using GPS/inertial exterior orientations for photogrammetric applications, in International Archives of Photogrammetry and Remote Sensing, Vol. 33 Part B3, pp. 198-205.

* Hussain, M. and Munjy R. (1999): GPS Controlled Photogrammetry For Large Scale Mapping, Final Project Report, New Technology & Research Program, California Department Of Transportation.
* Hussain, M., Munjy R and Appleton J. (2000): Reliability of On The Fly Kinematic GPS Data for Aerial Triangulation, GPS/ION 2000, Salt Lake City.
* Toth, C., (1998): Direct Platform Orientation of multi-sensor Data Acquisition Systems. In: Proc. ISPRS Congress Comm. IV, Stuttgart, pp. 629–634.

**VII – Deployment Potential**

Based on earlier research, Caltrans has very successfully deployed the use of airborne GPS for photogrammetric mapping. The development of calibration procedures and specifications for GPS/INS integrated systems will permit Caltrans to effectively deploy the use of digital aerial cameras for photogrammetric mapping as well as LIDAR for terrain mapping on a regular basis.