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ELECTRONIC ENGINEERING

Guidance, Navigation and Control of MAEU-01 UAV using MEMS Inertial Sensors

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***Abstract*—Applying Micro Electro-mechanical Systems (MEMS) inertial sensors for the Guidance, Navigation and Control (GNC) of an autonomous Unmanned Aerial Vehicle (UAV) is an extremely challenging area. This paper presents a practical approach of applying an Inertial Navigation System (INS) using MEMS inertial sensors, Global Positioning System (GPS) receiver, Magnetometer and Barometer for the GNC. The INS/GPS/Mag/Baro integrated navigation loop provides continuous and reliable navigation solutions to the guidance and flight control loop. The guidance loop computes the guidance demands from the current UAV states to satisfy mission requirements. The flight control loop generates actuator control signals to transports the UAV to the desired location. The whole GNC algorithm was implemented within an embedded flight control computer.**

***Keywords*: micro-electro mechanical system (MEMS); unmanned air vehicle (UAV); global positioning system (GPS); flight control; navigation**

I. INTRODUCTION

Unmanned air vehicles are nowadays seen as an area of great importance in the aerospace industry. In order to become successful, the cost of these systems has to be affordable. Thus researching on the Guidance, Navigation and Control (GNC) of a UAV using Micro Electromechanical Systems (MEMS) sensors is important. This paper present a MEMS sensor-based micro GNC system which is successfully applied to a UAV, as shown in Fig. 1. The physical UAV system comprises of the flight platform, onboard systems, communication links, and ground station. The UAV states are down linked to the ground station for UAV state monitoring. There are two flight control modes. In remote operation mode, the pilot on the ground sends the control signals to the actuator via wireless uplink channel. In autonomous mode, the navigation output is fed into the guidance and control loop and the onboard Flight Mode Switch redirects the computed control outputs to the actuators. The whole GNC algorithm was implemented within an embedded flight control computer. The UAV is a fixed wing platform with a pusher prop configuration. The real-time flight tests show that the navigation system can provide accurate and reliable 3D navigation solutions as well as to perform the guidance and control task reliable.

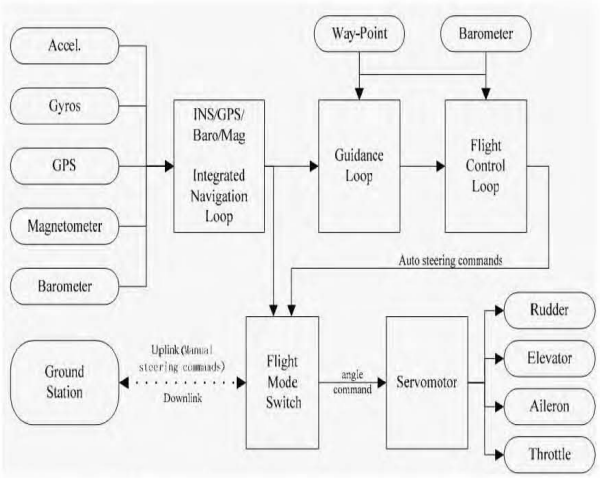

Fig. 1 The structure of MEMS sensor based GNC

II. AIRCRAFT SYSTEM

To meet the need of remote distance flight mission, the flight platform is designed as fixed wing platform with pusher prop configuration, as shown in Fig. 2 (a) and (b) It is capable of flying at 110 ft/s and up to 700 ft. The platform can carry 4 lb of additional mission payload. The following table shows the specifications for the flight platform.

TABLE 1
THESPECIFICATION FOR MAEU-01

UAV type	Short range platform
wing span	8 ft
overall length	5 ft 10 in
take off weight	20 lbs
payload	4 lbs
Endurance	30 min
Range	20 miles
Max: flight speed	110 ft/ sec
Min: flight speed	55 ft/ sec
Fuel weight	3 lbs
Takeoff/ landing	conventional runway
Communication System	(Using 10 channel Radio) LOS and Autonomous system