Anti-Jamming Antenna Configurations for GPS Receivers on Small UAS

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Autonomous small unmanned aerial systems (UAS) are finding increasing use in both the military and commercial sectors. Many of these devices rely on the Global Positioning System (GPS) for location positioning and waypoint navigation; however, this reliance opens the small UAS to vulnerabilities as GPS is highly susceptible to both intentional and unintentional jamming. This susceptibility can be mitigated by designing anti-jam features into the UAS GPS receiver antenna. A study of GPS antenna receiver anti-jam mitigation strategies is herein presented. A representative small, fixed-wing UAS is first examined to determine the operational and physical constraints of the UAS platform. This includes a discussion of a notional operational concept for the UAS to provide a model of the operational environment. The UAS itself is modeled to include onboard sensing and communication equipment needed to perform an array of mission profiles based upon this operational concept. Using the design constraints presented, GPS receiver antenna design solutions are then examined. This includes a survey of current offerings available on the market, as well as a discussion of research into spatial filtering and beam forming techniques. Special attention is paid to small controlled radiated pattern antennas (CRPA) and multi-antenna systems in regards to meeting the size, weight and power constraints of the UAS. A brief discussion of GPS receivers for each antenna solution is presented. The noise environment is then defined for the UAS to include unintentional and intentional sources, including an examination of the representative UAS model to identify possible cosite interference from onboard radiative sources. Finally, an analysis of the GPS receiver antenna configurations is performed to determine optimal parameters for jamming mitigation.