

Estimation of Flight State with a Collision Alert Radar

Based on FMCW Reflections of the Landscape for General Aviation

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Abstract—Although the main goal of a newly developed Collision Alert Radar is to observe airborne targets, it was found that reflections of the ground are received by the radar. The radar is carried on board of the aircraft, and the ground reflections may be used to detect flight information with respect to the terrain, something which is not possible with existing hardware. In this paper a method is developed which makes use of range and Doppler information from ground reflections, in order to provide the pilot with height and velocity information. The method was tested on a local flight in the Netherlands, with a prototype of the radar on-board. State results were compared to those of a GPS tracker on board. It was found that the horizontal and vertical components of the velocity were found with a standard deviation of about 3 m/s, and the height estimates had a standard deviation of 23 m. Also, a discrepancy of 36 m between the GPS and radar height estimates was found, which was caused by a fault in the GPS earth surface model, which was no problem for the radar. It is concluded that the quality of radar state estimates is approaching that of GPS measurements. The rapid developments in microwave sensing techniques can help the radar to surpass the quality of GPS in the coming years. If that happens, state estimation by radar can become an option for pilots who do not want to be dependent on the correctness of a terrain model, but who measure the terrain shape independently.