

Performance Analysis of Geophysical Database Referenced Navigation: The Combination of Gravity Gradient and Terrain Using Extended Kalman Filter

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Abstract : As an alternative way to compensate the INS (inertial navigation system) error in non-GNSS (Global Navigation Satellite System) environment, geophysical database referenced navigation is being studied. In this study, both gravity gradient and terrain data were combined to complement the weakness of sole geophysical data as well as to improve the stability of the positioning. The main process to compensate the INS error using geophysical database was constructed on the basis of the EKF (Extended Kalman Filter). In detail, two type of combination method, centralized and decentralized filter, were applied to check the pros and cons of its algorithm and to find more robust results. The performance of each navigation algorithm was evaluated based on the simulation by supposing that the aircraft flies with precise geophysical DB and sensors above nine different trajectories. Especially, the results were compared to the ones from sole geophysical database referenced navigation to check the improvement due to a combination of the heterogeneous geophysical database. It was found that the overall navigation performance was improved, but not all trajectories generated better navigation result by the combination of gravity gradient with terrain data. Also, it was found that the centralized filter generally showed more stable results. It is because that the way to allocate the weight for the decentralized filter could not be optimized due to the local inconsistency of geophysical data. In the future, switching of geophysical data or combining different navigation algorithm are necessary to obtain more robust navigation results.

Keywords : Extended Kalman Filter, geophysical database referenced navigation, gravity gradient, terrain

Conference Title : ICGNSS 2017 : International Conference on Global Navigation Satellite Systems

Conference Location : Barcelona, Spain

Conference Dates : August 17-18, 2017