A Robust Filtering Scheme for Attitude/Rate Estimation with GNSS Signals

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Abstract: Estimation of a mobile attitude or orientation is an important problem in many areas, such as satellite control, air and water navigation, and robotics. It consists of finding the relationship between a local coordinate frame attached to the vehicle and another frame considered as a reference. Attitude determination systems use known direction-of-arrival of some signals in the reference system, such as the light from a star, and measure these directions with sensors in the local frame. Global Navigation Satellite Systems (GNSS) signals are useful as well, since the position of the satellites and the vehicle are calculated by a standard GNSS receiver in the reference frame. Therefore, in a vehicle provided with an array of GNSS antennas with associated receivers tracking the incoming signals phase, the attitude can be estimated.

In this seminar a robust filtering scheme to determine the attitude and attitude rate of a vehicle, based on the phase measurements of GNSS signals will be presented. It uses a Kalman filter with state equality constraints that arise from the geometry of the problem, providing attitude angles (or Euler angles) and angular rate estimates. It also incorporates a measurement validation test (MVT) and an estimation integrity test (EIT) that makes it robust against frequent carrier phase disturbances such as cycle slips and outliers. Moreover, an ambiguity correction stage is also included. These features reduce the need of ambiguity re-initialization, which is both a computational burden and time consuming process. The whole scheme provides high accuracy attitude and attitude rate estimation with an arbitrary array (beyond 3 non collinear antennas). Simulated and experimental results will be shown.

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Host: Arye Nehorai

Bio: Javier Gonzalo Garcia received the Electronics Engineer degree from the National University of La Plata (UNLP) Argentina in 2003. He is currently a Ph.D. student with a scholarship of the National Scientific and Technical Research Council (CONICET) and a Head Teaching Assistant in the UNLP. His research interests are in statistical signal processing with applications to Global Navigation Satellite Systems (GNSS) and Digital Communications.