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Analysis of Translational Ship Oscillations in a Realistic Environment

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Abstract : To acquire accurate ship motions at the center of gravity, a single low-cost inertial sensor is utilized and applied on board to measure ship oscillating motions. As observations, the three axes accelerations and three axes rotational rates provided by the sensor are used. The mathematical model of processing the observation data includes determination of the distance vector between the sensor and the center of gravity in x, y, and z directions. After setting up the transfer matrix from sensor’s own coordinate system to the ship’s body frame, an extended Kalman filter is applied to deal with nonlinearities between the ship motion in the body frame and the observation information in the sensor’s frame. As a side effect, the method eliminates sensor noise and other unwanted errors. Results are not only roll and pitch, but also linear motions, in particular heave and surge at the center of gravity. For testing, we resort to measurements recorded on a small vessel in a well-defined sea state. With response amplitude operators computed numerically by a commercial software (Seaway), motion characteristics are estimated. These agree well with the measurements after processing with the suggested method.

Keywords : extended Kalman filter, nonlinear estimation, sea trial, ship motion estimation
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