

ORIENTATION DETERMINATION USING QUATERNION CALCULUS AND LINEAR KALMAN FILTERING. *B. Sipos, D. Phillips*, Department of Electrical Engineering, bjs5075@rit.edu, dbpeee@rit.edu*

Determining the orientation and position of a rigid body in a particular 3-space reference frame is a complicated subject that is currently being actively developed by a number of organizations. Recent advances in small, low-power, high-speed, high-word-length embedded processors have prompted this investigation into the use of quaternions as an end-to-end orientation storage and computation mechanism. While the filter function proposed is a Linear Kalman filter, the state error estimation mechanism is similar in function to an Unscented Kalman Filter but is an approximated closed-form solution. Most previous work involving orientation determination uses Euler angles, direction cosine matrices, or component-wise quaternion storage using traditional matrix algebra in Extended or Unscented Kalman Filters. These storage and computation mechanisms are inefficient and can produce unstable systems (error divergence or singularities). Using quaternion algebra allows data fusion of ambiguous measurements in a compact algorithm, but introduces complex error-propagation functions. Discussion will include historical background on quaternions and state-space filtering, current algorithm development, and simulated demonstrations.