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Attitude Dynamics (2) (2)

Author: Prof.Dr. William Silva
University of Brasilia, Brazil, reis.william@unb.br

Prof. Roberta Garcia
University of Sao Paulo, Brazil, robertagarcia@usp.br
Prof. Paula Pardal
University of Sao Paulo, Brazil, paulapardal@usp.br
Dr. Helio Koiti Kuga
Instituto Nacional de Pesquisas Espaciais (INPE), Brazil, hkakinha@hotmail.com
Prof. Maria Zanardi
São Paulo State University (FEG-UNESP), Brazil, mceciliazanardi@gmail.com
Dr. Leandro Baroni
Federal University of ABC, Brazil, leandro.baroni@ufabc.edu.br

ATTITUDE ESTIMATION USING EXTENDED H-INFINITY PARTICLE FILTER APPLIED TO CHINA-BRAZIL EARTH RESOURCE SATELLITE-4

Abstract

In this resource, a comparison is made between the Extended H-Infinity Particle Filter (EHInfPF) and the Particle Filter (PF) both applied to attitude estimation using simulated orbit and attitude measurement data for CBERS-4 (China Brazil Earth Resources Satellite 4) recently in operation. A common problem that often occurs with the particulate filter (PF) is the sample impoverishment. Using a small number of particles, at some point after resampling, the particles will mostly collapse towards the same value. Increasing the number of N particles can solve the problem but will increase the processing time. There are other smarter ways to deal with this sample impoverishment problem, but herein one proposes to use an extension of the H-Infinity linear filter for the nonlinear case of attitude estimation with non-linearity in both the dynamics and the measurement model. The aim is to highlight and magnify the properties of the H-Infinity filter in terms of its favorable characteristics. In the EHInfPF the nature (dynamics and noises) is assumed to be perverse and actively seeks to degrade our state estimate as much as possible, but the EHInfPF deals with it aiming ultimately at robustness using a reduce number of particles for the state estimation. The dynamic attitude model is described by quaternions and the available attitude sensors using for attitude estimation are two Digital Sun Sensors (DSS) with nonlinear functions of roll, pitch, and yaw attitude angles; two Infrared Earth Sensor (IRES) with direct measurements of roll and pitch angles; and a triad of mechanical gyroscopes that provide direct incremental angles or angular velocities. The results for attitude estimation show that it is possible to achieve precision in determining attitudes within the prescribed requirements using the EHInfPF, with lower computational cost and with a smaller number of particles when compared to the standard particle filter.