Project Introduction

Research on desensitized optimal filtering techniques and a navigation and sensor fusion tool kit using advanced filtering techniques is proposed. Research focuses on reducing the sensitivity of Kalman filters with respect to model parameter uncertainties using a robust trajectory optimization approach called Desensitized Optimal Control, developed by the proposing company. The proposed tool kit implements the research results as well as recent advances in robust and/or adaptive generalized Kalman and Sigma-Point filters for non-Gaussian problems with uncertain error statistics. The proposed research and development brings new filtering and sensor fusion techniques to NASA and industry in a convenient package which can be used as a stand-alone toolbox, either for ground support or for onboard applications. Its modular structure enables it to be readily integrated with other tools, and thus enhances the existing fleet of applications. The desensitized optimal filtering research and the feasibility study on components of the proposed tool kit will be carried out concurrently. The tool kit is a generic stand-alone application, and has a modularized structure which facilitates easy integration with existing tools. A suite of sensor models and noise distributions as well as Monte-Carlo analysis capability are included to enable statistical performance evaluations.

Anticipated Benefits

The proposed tool kit has applications in a wide range of industries besides NASA, including aerospace engineering, mechanical engineering, electrical engineering, atmospheric data assimilation and economic modeling, etc., where sensors are commonly used to collect a large quantity of raw data which need to be processed with filtering techniques. Specific examples of non-NASA applications may include marine vessel navigation, commercial airliner navigation, seismic data acquisition and analysis, atmospheric observation data collection and processing, and so on. The fact that the tool kit is built in a generic environment makes it readily applicable to any of these areas. Existing tools can also be enhanced by incorporating the advanced filtering modules provided in the proposed tool kit.
Primary U.S. Work Locations and Key Partners

Organizations Performing Work | Role | Type | Location
--- | --- | --- | ---
Glenn Research Center (GRC) | Lead Organization | NASA Center | Cleveland, OH
Goddard Space Flight Center (GSFC) | Supporting Organization | NASA Center | Greenbelt, MD
Jet Propulsion Laboratory (JPL) | Supporting Organization | NASA Center | Pasadena, CA

Primary U.S. Work Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>Maryland</td>
</tr>
<tr>
<td>Ohio</td>
<td>Virginia</td>
</tr>
</tbody>
</table>

Organizational Responsibility

Responsible Mission Directorate: Space Technology Mission Directorate (STMD)
Lead Center / Facility: Glenn Research Center (GRC)
Responsible Program: SBIR/STTR

Project Management

Program Director: Jennifer L Gustetic
Program Manager: Carlos Torrez
Project Managers: Bryan W Welch, Gary Jahns
Principal Investigator: Christopher D Karlgaard

For more information and an accessible alternative, please visit: https://techport.nasa.gov/view/9548
Closeout Documentation

Final Summary Chart
(https://techport.nasa.gov/file/13915)

Technology Maturity (TRL)

Start: 4
Current: 3
Estimated End: 6

Technology Areas

Primary:
- Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
  - Position, Navigation, and Timing (TA 5.4)
  - Sensors and Vision Processing Systems (TA 5.4.3)

Other/Cross-cutting:
- Modeling, Simulation, Information Technology and Processing (TA 11)