Project Introduction

It is proposed to develop desensitized optimal filtering techniques and to implement these algorithms in a navigation and sensor fusion tool kit. These proposed desensitized optimal filtering techniques include recent advances in robust and/or adaptive generalized Kalman and Sigma-Point filters for non-Gaussian problems with uncertain error statistics, as well as a proposed new technique to desensitize the Kalman filter with respect to parameter uncertainties using a robust trajectory optimization approach called Desensitized Optimal Control. These techniques will be implemented in a relatively generic environment which enables the user to import dynamics and measurement models necessary to apply these filtering techniques to a particular navigation and sensor fusion problem. A variety of sensor models and noise distributions will be available for the user to select, and Monte-Carlo analysis capability will be built into the tool kit to enable statistical performance evaluations. The tool kit will also have a modularized structure so that the modules can be readily integrated with other applications.

Anticipated Benefits

Potential NASA Commercial Applications: The proposed tool kit has applications in a wide range of industries, 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, seismic data acquisition and analysis, atmospheric observation data collection and processing, customer behavior analysis, and so on. The fact that the tool kit is built in a generic environment makes it readily applicable to any of these areas, assuming suitable dynamics and measurement models are provided. Existing tools can also be enhanced by incorporating the filtering technique modules provided in the proposed tool kit.
Primary U.S. Work Locations and Key Partners

<table>
<thead>
<tr>
<th>Organizations Performing Work</th>
<th>Role</th>
<th>Type</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>★ Glenn Research Center (GRC)</td>
<td>Lead Organization</td>
<td>NASA Center</td>
<td>Cleveland, OH</td>
</tr>
</tbody>
</table>

**Primary U.S. Work Locations**

- Ohio
- Virginia

**Project Management**

- **Program Director:** Jennifer L Gustetic
- **Program Manager:** Carlos Torrez
- **Principal Investigator:** Christopher D Karlgaard

**Technology Maturity (TRL)**

- Start: 3
- Current: 3
- Estimated End: 3

**Closeout Documentation**

- Final Summary Chart (https://techport.nasa.gov/file/14824)
- Final Summary Chart Image (https://techport.nasa.gov/file/21533)