Developing ISR Communication Systems Using The MathWorks’ Tools

Tim Reeves
Applications Engineer
UAV-based Communications and ISR
Design Objectives

- Increase useable range of UAV from 100 km to 200 km and maintain video performance

Design Approach

- Explore different design alternatives including use of different radio implementations and / or different antenna selections.
System Design Challenges

- Multiple design disciplines
  - Mechanical modeling
  - Communication System modeling
  - Video and Image Processing modeling

- Design Groups working at different locations
  - Work in different facilities / different time zones

- What will happen during the final integration stage?
Required System Design Capabilities

- Single Design Environment supporting multiple design disciplines
  - Libraries of pre-built blocks that cover mechanical, communications and video processing design domains

- Continuous Design Verification
  - Single design environment that can be used so as to validate the design at each stage of the design process

- Model Sharing
  - Be able to share models between different teams and locations
External Factors

- Shrinking development cycles
  - Pressure from customers to develop systems in a shorter time frame with superior performance.

- Growing Design Complexity
  - Vehicles and other related equipment need to have more functionality than ever before.
UAV Demonstration

Communications + Video Imaging Subsystem

Mechanical Subsystem

Pointing Target
Controller
Antenna
Custom Libraries

- Allows others access to custom Simulink subsystems that you have developed
- Repository of models that you or your colleagues can use in future designs
Embedded MATLAB Function Block

- Fast execution
- Generates C code (with Real-Time Workshop®)
- Multiple input and output ports
- Modular code: multiple blocks
- Integrated editor
## End Results

<table>
<thead>
<tr>
<th>Design Challenge</th>
<th>Solution</th>
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<tbody>
<tr>
<td>Design and verify communications subsystem</td>
<td>- model different communications schemes using a library of Radio Models</td>
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<tr>
<td>Design and verify Video compressions</td>
<td>Use Video and Image Processing Blocksets to model video algorithms</td>
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<tr>
<td>Access impact of antenna selection</td>
<td>Incorporate MATLAB antenna models in Simulink model using Embedded MATLAB</td>
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<tr>
<td>Access impact of stabilization system</td>
<td>Model antenna gimbal and controller with SimMechanics</td>
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<td>Integrate systems in simulation</td>
<td>Use Simulink to integrate multiple domains into single system level model</td>
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<td>Optimize design at a system level</td>
<td>Model a number of different design alternatives as well as key parameters such as maximum operating distance</td>
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Next Steps

- Incorporate this model into a broader system simulation
  - flight dynamics
  - target tracking
Products Used

- Simulink
  - Embedded MATLAB blocks
- Video and Imaging Processing Blockset
  - Segmentation, motion estimation, morphology and more
- Communications Blockset
  - Source coding, error correction, modulation and more
- Signal Processing Blockset
  - Estimation, filtering, linear algebra, statistics, FFT, and more
- SimMechanics
  - Physical Modeling