Name of Project: Mobile Platform deployed Synthetic Aperture Radar (SAR)

Abstract
Radiant Solutions is sponsoring development of autonomous mobile sensing on hexacopter applications. This is a multi-year effort that builds on efforts from prior MDP teams. This project aims to create a versatile set of assets for a flying platform, and develop practical, reliable means of using them in applications.

The 2019 MDP team will integrate and test a lightweight radar sensor, and apply it as a Synthetic Aperture Radar (SAR). Effort will go into building a workable on-board SAR collection capability, and successfully processing the result as a SAR image. Students will gain experience using the DEMORAD board from Analog Devices. (http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/eval-demorad.html)

(Note: In the event that the radar is not available for the 2019 year, an alternate sensor will be chosen. Efforts will proceed with multi-spectral or polarimetric electro-optical sensors)

Impact
With the advent of cheaper, lightweight sensors, longer battery life, and advances in vision and signal processing, new opportunities have arisen for using small autonomous (and manually controlled) flying vehicles for environmental sensing, maintenance and inspection, search and rescue, and other applications. Because the challenges change on a regular basis, a flexible, modular system is desired to meet emerging needs.

Scope:

Include a Deliverable (Phase I) and Details Here: BASELINE GOAL
What is the baseline deliverable the students must produce in order to be successful?
Students will integrate a lightweight radar test board on a Matrice 600 pro hexacopter. Efforts will include development of a SAR-specific mode, and control of the transmit/receive system. This will be controlled by the Matrice 600 while in flight with a flight path and geometry appropriate for this sensor modality.

Include a Deliverable (Intermediate - Phase II) and Details Here: SUCCESS
What is the polished/functionality the students should plan time to add?
Students will adapt the output of the SAR collection to successfully process SAR imagery using Radiant Solution’s SAR processor. Upon successful processing, students will analyze results to determine needed hardware or software improvements that to improve image quality.
### Student Skills:

<table>
<thead>
<tr>
<th>Project Roles</th>
<th>Key Skills and/or Knowledge</th>
<th>Likely Majors</th>
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<tbody>
<tr>
<td>Systems Integration (1)</td>
<td>Systems engineering, broad well established engineering skills, (should have competency in either embedded systems, algorithm development and/or data processing)</td>
<td>ISD- Systems Engineering</td>
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<tr>
<td>Embedded systems (3)</td>
<td>Integration circuitry, intermediate processing requirements, in flight data management and data storage</td>
<td>CE, EE, CS</td>
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<tr>
<td>Algorithm Development and Data Processing (3)</td>
<td>Design and adapt SAR processing algorithms (Python, potentially Matlab, C++) to function within the hardware constraints</td>
<td>Computer Science, Data Science, Mathematics</td>
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**Additional desired skills & interest:**

Any of the following Skills, Knowledge or Experience would be valuable to the 2019 team. We don’t expect students to be familiar all or even most of these items, but strong candidates will have familiarity or experience with some of them and a positive attitude to learn what is necessary as the project gets underway. Please highlight your experience with any of the items on this list in your personal statement on the application.

- Team design and development experience
- Team Organization and Leadership experience
- Python, Matlab, and/or C++
- Experience with SAR processing methods and techniques
- Sensor development experience
- Fabrication Experience
- Practice experience with drone flight and control
- Experience with general mechatronics and digital control systems
- Project Management experience
Location:
Most project work will take place on campus. There will be periodic meetings held at MDA US in Ypsilanti. (Transportation will be provided by MDP)

FACULTY MENTOR:
TBD

Sponsor Mentor:
Sponsor Mentor: Richard Spangler
UM Masters in Applied Interdisciplinary Mathematics, 2010, BSEE from University of Detroit, 1994. Mr. Spangler has worked as an engineer for MDA LLC and predecessor companies since 1997. Current research interests involve the automated extraction of target information from image data, particularly for Synthetic Aperture Radar (SAR). Other work has included development of image processing and analysis algorithms for SAR, bistatic radar, and interferometry. Other work also includes system engineering involving radar systems, orbitology, and other applications; as well as field work for deploying experimental systems.

Legal Requirements:

Citizenship Requirements (please select)
• Student must be a US Citizen (As required by law, regulation, executive order, or government contract)

Intellectual Property Agreements / Non-Disclosure Agreement Requirements (please select)
• Students will sign the standard MDP IP/NDA agreement

Internship Information:
• Interviews guaranteed for all students on our team who are interested in a Summer 2019 internship. Interviews will be conducted in December.

Company Information:
Radiant Solutions provides multi-source data collection, enrichment, and analytic capabilities that reveal unique geospatial information and insights where and when it matters.
OUR PURPOSE

Help our customers understand and navigate our changing planet.

OUR CUSTOMERS

Leading U.S. Defense and Intelligence agencies

Multiple Allied Nations

Hundreds of Commercial Customers

WHY NOW

Pervasive data-gathering sensors, open source software, cloud computing, machine learning, and big data analytics have provided the means to reveal insight at global scale.

WHY US

No company has such strong roots in geospatial with our level of scale and a strong commercial mindset. MDA Information Systems, RadiantBlue, DigitalGlobe Intelligence Solutions, and HumanGeo are well known for delivering innovative capabilities across each phase of the geospatial intelligence cycle. Our combined team of over 1,000 aerospace engineers, geospatial analysts, weather and ocean experts, software developers, data scientists, and DevOps engineers apply disruptive technology and our unique intellectual property to both national security and commercial problems.

BELOW THE LINE NOT INCLUDED IN THE STUDENT FACING MATERIALS – TECH NOTES accompanying the project

Notes from Rick Spangler Mentor

The radar sensor components will be provided to the UM MDP team by Radiant Solutions. We are planning on using the DEMORAD board from Analog Devices (http://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/eval-demorad.html)

The provided sensor has a send/receive capability, so they should be able to operate with that. The board will interface with a small computer like a raspberry pi in order to access storage and interface with the data.

If for any reason we are not able to obtain the radar board, our plan B will be to purchase a polarized camera (Blackfly S Polarized 5.0 MP USB3 Vision (Sony IMX250MZR), Part Number BFS-U3-51S5P-C) and proceed from there.