Ganged Phased Array Radar – Risk Mitigation System (GPAR-RMS) June-September 2010 Accomplishments

AUVSI – North America 2010 Conference

This conference was well attended by UND faculty, staff, and students. Prof. Ben Trapnell presented information regarding the establishment of an unmanned aircraft systems degree program at UND. Prof. Doug Marshall presented information regarding obtaining certificates of authorization (COA) over international waters, and Chris Theisen presented, with a poster, airspace climatology results obtained using data collected from 4-12 October 2008 during the University and National Guard Air Truth Study (UNGATS), which is a collaborative mission between UND and the North Dakota National Guard 188th Air Defense Artillery Battalion. All presentations were very well received.

The GPAR-RMS project also supported an exhibit booth that was heavily visited. Displayed at the booth were the GPAR-RMS visualization system, video of Scan Eagle flood operations conducted during the spring of 2010 near Oslo, MN, and information regarding other Unmanned Aircraft System (UAS) efforts at UND including the newly developed degree program. (For conference info see http://symposium.auvsi.org/auvsi10/public/content.aspx?ID=116&sortMenu=107001.)

SCAN EAGLE MISSION SUPPORT VEHICLE

A mission support vehicle (MSV) was purchased from INSITU, Inc. This vehicle provides valuable support for ScanEagle operations and includes a two-dimensional phased-array radar produced by DeTech, Inc. The data collected with this radar provides horizontal locations of targets and will be very useful for testing the GPAR-RMS. Systems in the MSV can also be used to collect TCAS, weather, and lightning data. All information from the support vehicle will be sent to the command center, where the ScanEagle Ground Control Station (GCS) and GPAR-RMS operations are located. This information can then be ingested into the GPAR-RMS visualization system to aid in providing situational awareness to the UAS pilot. The mission support vehicle arrived at UND on 25 September 2010.

Image of UND's mission support vehicle.

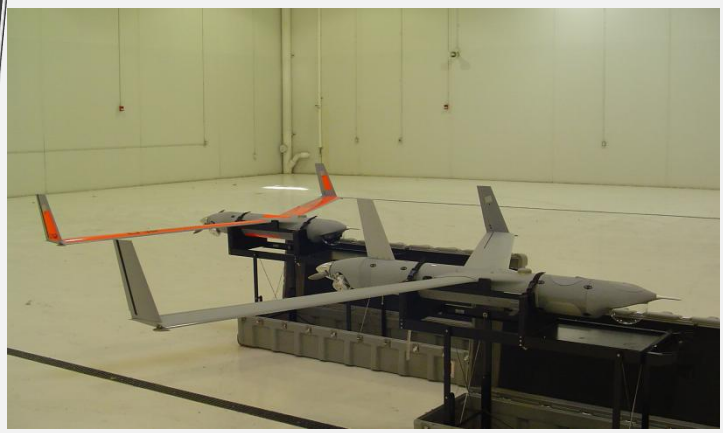

Image of the Dual Bay ScanEagle (forward) and the Single Bay Scan Eagle (back).

DUAL BAY SCAN EAGLE

A second ScanEagle with an extended body and a second payload bay was purchased from INSITU, Inc. and utilizes all of the equipment (launcher and recovery system) acquired with the first ScanEagle. The second payload bay on this ScanEagle is located just behind the front EO/IR camera bay, with another empty extension to the airframe just in front of the engine to provide proper balance for flight. The dual bay ScanEagle will be used in payload development and testing. Initial test flights with this aircraft will be conducted during the Fall of 2010.

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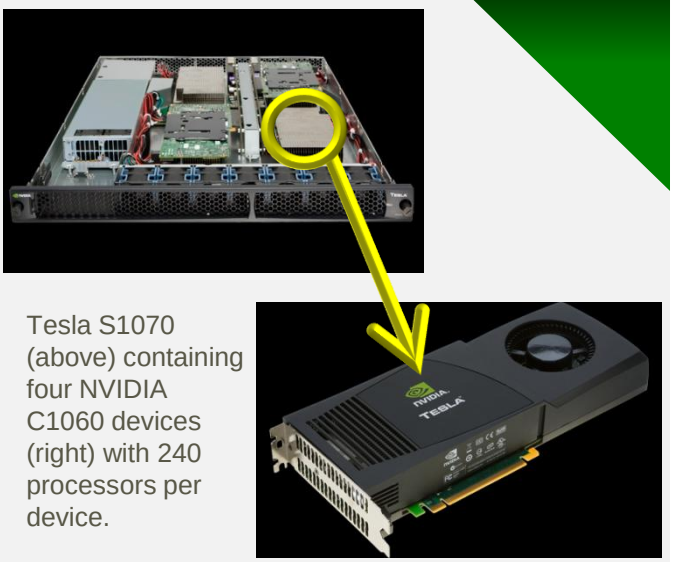
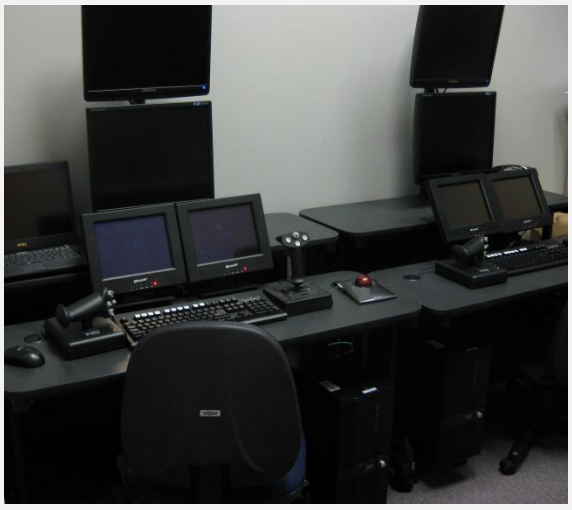
Ganged Phased Array Radar – Risk Mitigation System (GPAR-RMS) Recent Accomplishments

NVIDIA CUDA MONTE CARLO SIMULATIONS

In the computation of instantaneous risk within the GPAR-RMS Monte Carlo simulations are used to estimate the likelihood of aircraft collisions in a three-dimensional volume of airspace. These simulations require computations of millions of flight tracks for every aircraft interaction scenario and is extremely computationally expensive—taking weeks to run on a regular computer. This process is being ported to a Tesla S1070 (top image) computer that utilizes four NVIDIA C1060 devices (bottom image). The Tesla S1070 is a (1U) rack-mount server and each NVIDIA C1060 has 240 processors. These Monte Carlo simulations are well suited for the NVIDA CUDA architecture which will produce, if fully utilized, one teraflop of computational power. This eliminates the need for a large cluster of computers to handle the Monte Carlo simulations and enables these computations to complete much faster. One CUDA device can work on 26,000+ flight tracks simultaneously as compared to a traditional, single CPU being able to work on only two tracks at a time. This allows the entire computer to process 100,000+ flight tracks simultaneously. It is anticipated that this process will enable the calculation of a risk value in near real time for flying UAS in the National Airspace System (NAS). Initial tests using the CUDA architecture have been completed.



Tesla S1070 (above) containing four NVIDIA C1060 devices (right) with 240 processors per device.

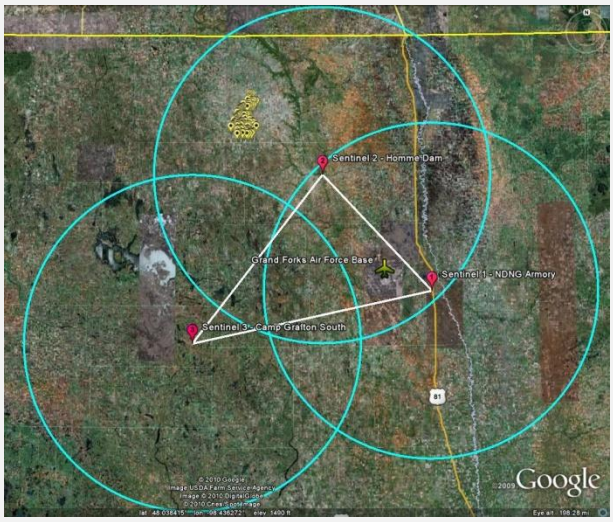


ROVATTS™ MQ-1 and MQ-9 SIMULATORS

Two ROVATTS™ simulators have been purchased from SDS International, which enables the simulation of both the MQ-1 Predator and the MQ-9 Reaper unmanned aircraft. These simulators have been integrated with a UFA radar simulator used in the Air Traffic Control degree program. This simulation capability is being used to test unmanned aircraft/ATC interactions and, thus, to develop procedures for the integration of unmanned aircraft into the NAS. Such a simulation capability could be used to train UAS pilots regarding MQ-1 and MQ-9 systems and to train ATC students regarding scenarios involving unmanned aircraft.

NATIONAL GUARD COLLABORATION

UND has previously collaborated (4-12 October 2008) with the North Dakota National Guard (NDNG)188th Air Defense Artillery Battalion to develop an airspace characterization above and around the Grand Forks Air Force Base. A similar data collection effort was conducted from 16 August 2010 through 24 September 2010. This collaboration includes data collection using three tactical MPQ-64 Sentinel radars at selected locations in eastern North Dakota (right) and was termed the University and National Guard Air Truth Study (UNGATS). The data are being collected through the help of the Aviation & Missile Research, Development, and Engineering Center (AMRDEC) from the Redstone Arsenal – Huntsville, AL. These data will be used to produce statistics regarding aircraft concentrations and airspace usage as well as to serve as a demonstration of the GPAR-RMS concept. These data will also be used at the Massachusetts Institute of Technology – Lincoln Laboratory in aircraft encounter models to produce risk associated with flying unmanned aircraft in eastern North Dakota. This airspace characterization is anticipated to aid UAS NAS integration in North Dakota.



UNGATS operational area.