CENTER FOR UAS RESEARCH, EDUCATION & TRAINING
JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES
THE UNIVERSITY OF NORTH DAKOTA

Ganged Phased Array Radar – Risk Mitigation System (GPAR-RMS) Spring 2011 Accomplishments

RED RIVER VALLEY FLOOD OPERATIONS

Flood image from the ScanEagle.

Pre-flight image of the ScanEagle.

For the second year in a row operations were conducted near Oslo, MN, while the Red River Valley of the North was flooding. Tests were performed using UND's ScanEagle UAS. Flights (28 March 11 April, and 20 April of 2011) were conducted near the river-stage peak and aerial video and pictures of the extent of flooding were captured. The primary purpose of these flights was to test elements of a system developed to enable UAS NAS integration—specifically software and hardware components of the GPAR-RMS that were recently integrated into the command and control center (C3) (co-located with the Scan Eagle GCS). The GPAR-RMS currently uses ADS-B and UAS GPS data to identify cooperative air traffic. Work is currently underway to integrate radar data into the GPAR-RMS to identify non-cooperative air traffic. Providing such cooperative air-traffic data in the field during UAS operations has proven to be invaluable. On several occasions this information was used to enhance the situational awareness of ground observers so that they could visually track incoming aircraft sooner than would have otherwise been possible. Also, UAS pilots were able to use this information to maneuver UA away from other aircraft that were approaching the COA to minimize risk.

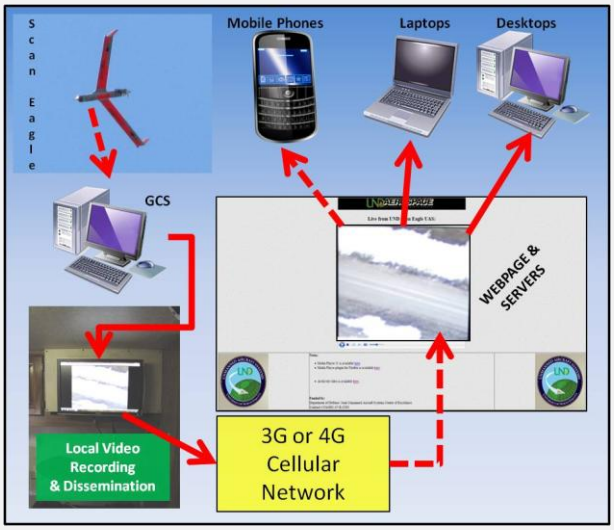
Great strides were made in the development of the GPAR-RMS during the spring of 2011. Future efforts will be directed towards refining and finalizing this system, with continued data collection and system testing.

ScanEagle deployment on 28 March 2011.

LIVE UAS VIDEO STREAMING OVER 3G NETOWRK

One possibility that has been explored is providing live video from a UAS directly to personnel at different locations across the U.S. as well as to personnel in the field. This capability would be very helpful, especially if a system like the GPAR-RMS were used in a Defense Support to Civil Authorities (DSCA) role. Video was successfully transmitted and received during spring 2011 UAS flights. Efforts are currently being directed to improve this capability.

Live video from the ScanEagle UAS was sent to a local computer, which recorded the video and disseminated it to a webserver at UND through the Verizon 3G cellular network. The webserver then provided this real time video through and internet connection to laptop and desktop computers. A separate webserver is being configured to reduce the bandwidth and resolution of the video so that mobile phones would be able to access the video. Reducing the video resolution is needed to help prevent saturation of local cellular networks.



Flow diagram of video streaming from the ScanEagle UAS during deployments (dashed lines are wireless links).

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VISUALIZATION AND FUSION INTEGRATION

The visualization system takes information from a multitude of sensors and equipment and fuses the data to provide a common air traffic picture to the end user. This system was developed to be user friendly and not require a degree in air traffic control to interpret the displays. This is the heart of the GPAR-RMS and was integrated into the command and control center (C3) to provide situational awareness to the UAS pilot. This system has two displays. One display (GOIDS) is UAS centric and provides information regarding air traffic relative to the UAS to the ground observer stationed in the C3. This display was also placed in the ScanEagle GCS so that pilots could view and test this display (communications between the pilots and the ground observers can also be tested). The second display (RCCIDS) is provided to the range control officer who oversees air traffic on a geo-referenced map to monitor the overall airspace and safety of the system. The RCCIDS can also show local weather radar data. This display provides information to help the range control officer determine if operations should be terminated (owing to safety reasons).

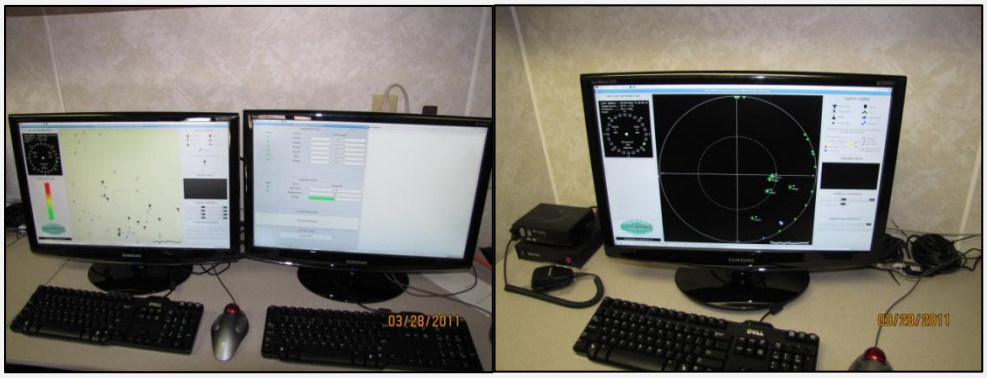


Image of the RCCIDS (left) and the GOIDS (right) in the command and control center.

Computer system that runs the GPAR-RMS visualization and fusion systems.

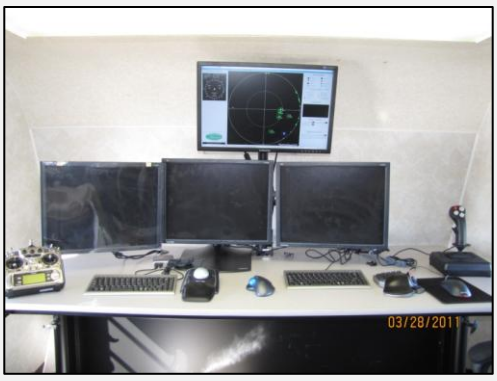
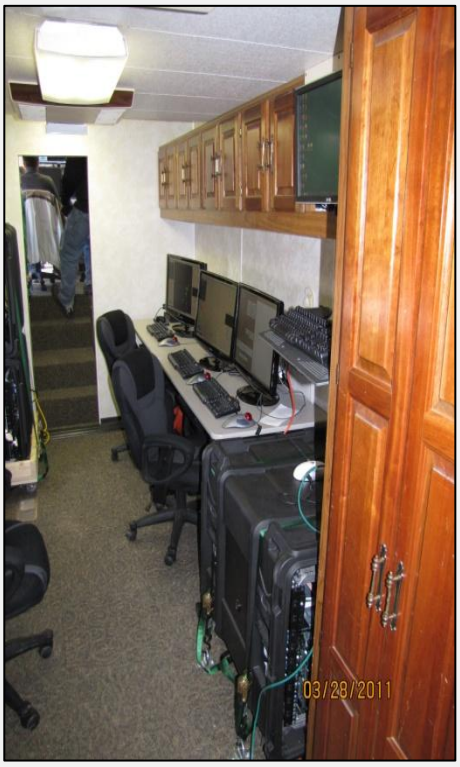


Image of the ScanEagle GCS with integration of the GOIDS (top monitor).



View of the inside of the command and control center. Left side of image is the GPAR-RMS and the stairs in the background lead to the ScanEagle GCS.

ATC Radar / UAS Pilot Interaction Study

The University of North Dakota has a renowned aviation school that utilizes many advanced simulators for education and training. The UAS program at UND was able to purchase two SDS Predator UAS simulators that have been directly connected to one of these simulators—the UFA ATC radar simulator. With this one can study ATC/UAS pilot interactions. Several tests were conducted to evaluate response times (both action initiation and action completion) for requests issued to the MQ-9 simulation pilot by ATC personnel. These tests were configured to incorporate multiple activities (e.g., multiple turns, airspeed changes, and altitude changes) during each of the three phases of flight: departure, en-route, and arrival. A total of ~55 simulated flights were completed. Fifty of these flights were piloted by UND flight instructors and five were completed by pilots having less experience. Analysis of these results include, but are not limited to, determining mean time to respond to ATC requests, mean time to complete the required action, and standard deviations of these times. Efforts are being directed at performing similar studies with manned aircraft simulators to obtain baseline statistics to compare with the UAS results. Results of these studies are still being analyzed.