

## **Argus Development and Support**

Rob Holman  
SECNAV/CNO Chair in Oceanography  
COAS-OSU  
104 Ocean Admin Bldg  
Corvallis, OR 97331-5503  
phone: (541) 737-2914 fax: (541) 737-2064 email: [holman@coas.oregonstate.edu](mailto:holman@coas.oregonstate.edu)

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### **LONG-TERM GOAL**

The long-term goal of nearshore processes research has been to develop a predictive understanding of the fluid dynamics of a random wave field shoaling over the complicated bathymetry of a natural beach, and the response of the beach to those overlying wave and current motions. Due to the complexity and nonlinearities of the system, predictions at most time scales depend on frequent data updates, likely acquired through innovative remote sensing techniques. The Argus Program, developed by the Coastal Imaging Lab (CIL), is one such approach (<http://cil-www.coas.oregonstate.edu:8080>). Technology developments in Argus are important to a range of nearshore dynamics research programs and apply readily to other remote sensing programs of Naval interest.

### **OBJECTIVES**

Argus is a global program, with 12 stations in 5 countries. While the program was invented at Oregon State University and we continue to be the intellectual lead, major complementary development programs have begun in Europe (Netherlands and England), the US (NRL-SSC) and Australia. With the research benefit associated with these efforts come corresponding complications of organizing and maintaining coherency among the groups. This is particularly true in Europe where research is funded as part of the three-year EU CoastView program.

The objectives of the work in this grant are threefold:

- a) to provide support for operations including replacement parts and maintenance to cover normal system attrition, as well as mirrored archive with Stennis Space Center
- b) to allow the design and testing of the third generation Argus Station based around digital firewire cameras and all-digital networks, and
- c) to maintain connections and coherency with other world Argus developers.

# Report Documentation Page

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## **APPROACH**

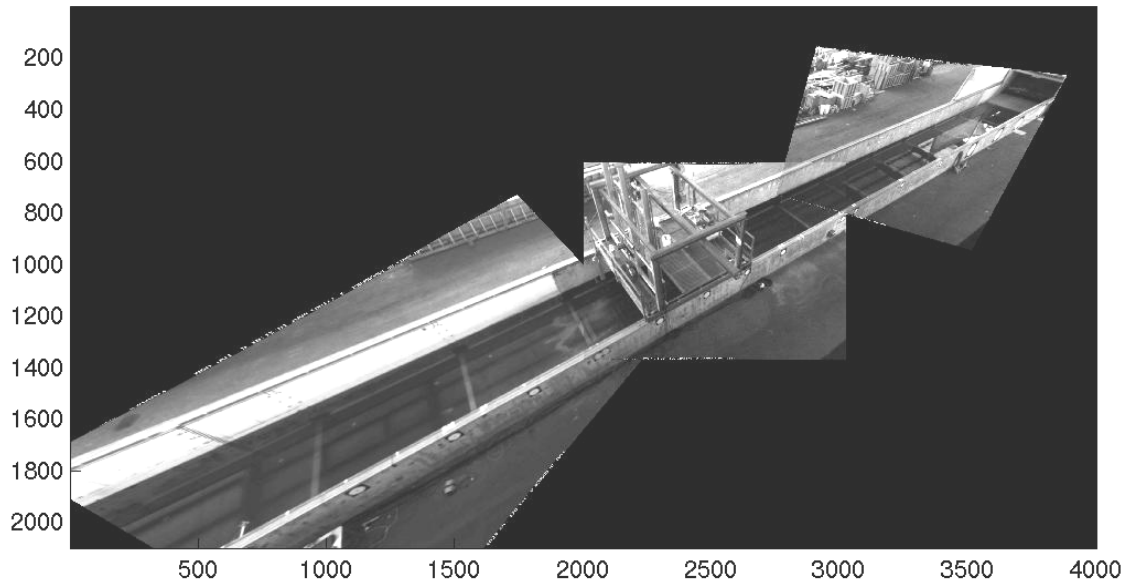
This work continues to involve reactive and proactive components. The reactive component involves: i) replacement of failing system components, primarily by shipping parts to colleagues and tutoring the fix by phone or email, ii) bug recovery usually associated with changes in firewalls or other aspects of site infrastructure, and iii) response to a wide range of queries and requests from collaborators. The proactive component involves: a) improvements in the system, particularly the development of the new, digital Argus III, b) improvements in operations and development of new base-level routines and techniques that are the foundation of Argus, and c) communications among the Argus user community to encourage and align ongoing development. In addition, this grant supports regular operations, although these and almost entirely automated at this stage.

## **WORK COMPLETED**

Now in its third year, the primary activity has been the development and testing of the digital Argus III stations, prior to replacement of each of the existing Argus II stations. An initial FireWire configuration was used during the recent NCEX field experiment in Southern California. While quite successful, several lessons were learned about the idiosyncrasies of FireWire and we have now revised the design of Argus III. In particular, we have settled on a standard camera with few internal smarts, such that all aspects of the imaging process remain under our control. This version is being tested at several sites.

One of the test sites has been the Hinsdale Wave Lab at Oregon State University (the first laboratory installation of Argus). This installation has provided rigorous tests of the new system, in part because much higher sampling frequencies were required for the smaller-scale lab waves.

We have also partially transitioned our image processing algorithms from an older approach to photogrammetry to methods based on homogeneous coordinates [*Hartley and Zisserman, 2003*], that should offer many advantages and simplifications. For example, figure 1 shows a merged oblique image from the new Hinsdale Wave Lab Argus Station that is easily accomplished with homogeneous coordinates.



***Figure 1. Merged oblique image of the Hinsdale Wave Lab. This image was created by projecting the views from each of the three station cameras into the projective geometry of the middle camera, a task simplified through the use of homogeneous coordinates.***

The CIL has also hosted Argus User workshops on an 18-month basis. The sixth such workshop was held in Oregon in August, 2004 and drew 42 attendees from 5 countries.

## **IMPACT/APPLICATION**

Argus has become increasingly important in Europe and Australia, with installations now in seven countries over three continents and serious Argus research in five countries. Approximately 35 stations are now in operation. Within the US, Argus and associated spin-offs will play a major role in the NCEX field experiment, now in progress. Argus is also an increasingly important part of Naval nearshore remote sensing research, for example in the VISSER program, run by Dr. Todd Holland at NRL-Stennis Space Center.

## **TRANSITIONS**

Aspects of Argus research development have been integrated in Naval nearshore remote sensing programs through the PI's connections to the LRS program. Transition to the WSC of some of these results is ongoing or complete as of the time of writing.

## **RELATED PROJECTS**

- 1 - Joint work with Dr. Todd Holland, NRL-SSC
- 2 – Collaboration with WSC personnel at Navoceano (headed by Melody Bledsoe and Houston Costolo) on nearshore remote sensing

3 – LRS program collaboration

4 – EU CoastView Program (2002 – 2005)

5 – Numerous collaborations with the Field Research Facility

6 – Participation in the NCEX field experiment, 09/19/03 – 11/15/03

7 – Collaboration with the Ocean Engineering Group at OSU

## **REFERENCES**

Hartley, R., and A. Zisserman, *Multiple view geometry in computer vision*, 665 pp., Cambridge University Press, 2003.

## **PUBLICATIONS**

Holman, R.A. Stanley, J.A, and H.T. Özkan-Haller, The application of video sensor networks to the study of nearshore oceanography, *IEEE Journal of Pervasive Computing*, 2(4), 14-21, 2003.

## **PATENTS**

None

## **HONORS/AWARDS/PRIZES**

SECNAV/CNO Chair in Oceanography, 2003-2007