Dual-Beam Interferometer Development and Validation

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LONG-TERM GOALS

My long-term goal is to contribute to our understanding of the upper ocean and lower atmosphere through the development and application of microwave, acoustic, and optical remote sensing techniques.

OBJECTIVES

The objective of this effort is to develop an instrument and techniques to estimate surface current vectors from aircraft using along-track interferometry.

APPROACH

A low-cost dual-beam interferometric radar termed the Dual-Beam Interferometer (DBI) has been designed and constructed. The radar is an along-track interferometric SAR producing two beams, one squinted forward and one squinted aft. The two interferometer beams yield two components of the surface Doppler velocity from which surface current is estimated. The instrument has been packaged into a wing-mounted pod suitable for mounting on NOAA WP-3D research aircraft, or other aircraft with compatible mounting pylons. Testing of the instrument will occur in October 2002 over the Tampa Bay area. This will be in preparation for a joint nearshore study in November 2002 with Mark Sletton from NRL at the US Army Engineer's Field Research Facility (FRF) Pier near Duck, NC.

WORK COMPLETED

In October 2001, the instrument chassis was sent to Zivko Aeronautics for the construction of the pod. This was delivered in in May 2002. During this time, the embedded software and on-

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board control electronics were integrated with the existing RF electronics and repackaged into the chassis. The RF electronics were also upgraded to include to higher power microwave amplifier for increased sensitivity and the effect of the instrument chassis on the antenna patterns was measured. From May to August, the data acquisition system was integrated into the radar.

At the end of August, the instrument was taken to MacDill Air Force Base in Tampa, FL to be mounted on the NOAA WP-3D (N43RF, see Figure 1). The instrument mounts to the bottom of the wing near the fuselage on the port side of the aircraft (right hand side in the figure). Figure 2 shows the top of the pod and the chassis mounted under the aircraft wing. The two forward looking antennas (white rectangles) can clearly be seen at the front and the read of the instrument chassis. These are separated by approximately 1 meter which provides the along-track interferometric baseline. The aft looking antennas can also be seen on either side of the chassis above the forward looking ones. The instrument electronics is packaged into the cube between the antennas. The bottom of the pod (the shell) is not shown.

RESULTS

Due to the hurricane research program based at MacDill Air Force Base, the NOAA WP-3D was involved in hurricane research flights. Although we were able to mount the instrument to the wing, we were unable to schedule the planned test flights during September. Therefore, no flight measurements are currently available. However, an engineering field test of the instrument at the University of Massachusetts was preformed which involved the acquisition of range profiles of the surrounding area. An example of a range profile is shown in Figure 3. The reflections from a tall building at approximately 2500 meters can clearly be seen which shows that the radar is functioning. Other targets such as trees can be seen closer to the radar.

IMPACT/APPLICATIONS

Along-track interferometric SARs commonly provide a single component of surface Doppler velocity. The ability to obtain surface velocity *vector* estimates in a single aircraft pass would permit long distance strip mapping of current vectors in, for example, coastal regions.

TRANSITIONS

None.

RELATED PROJECTS

Using the FOPAIR imaging radar developed at UMass, we are also investigating the utility of imaging Doppler radar for use in estimating currents and wave heights within and just beyond the surf zone.

REFERENCES

Rodriguez, E., D. Imel, B. Houshmand, 1995: “Two Dimensional Surface Currents Using Vector Along-Track Interferometry”, *PIERS’95 Proceedings*, Seattle, WA, p. 763.

Figure 1: NOAA WP-3D (N43RF) research aircraft.

Figure 2: DBI instrument frame and pod top mounted on the NOAAWP-3Dwing(podshellnot shown).

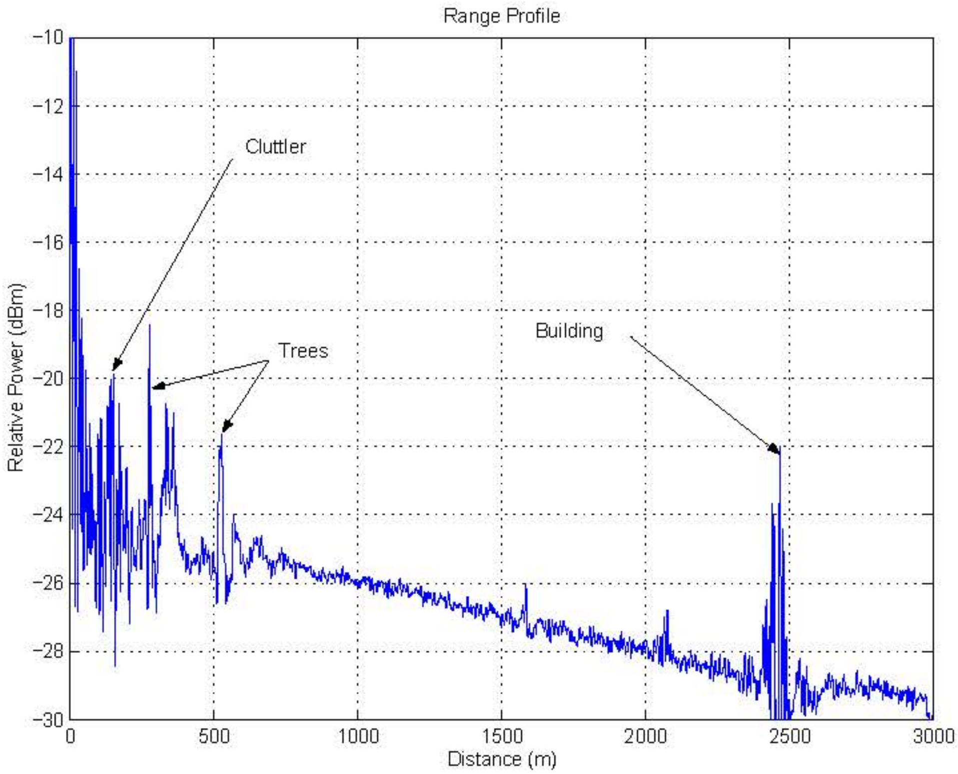

Figure 3: Backscatted power measured by DBI while pointed towards a tall building.

PUBLICATIONS

Frasier, S.J., and A.J. Camps, 2001: "Dual-Beam Interferometry for Ocean Surface Current Vector Mapping", *IEEE Trans. Geosci. & Rem. Sensing*, **39**(2), 401–414.