Two-Dimensional Surface Currents in the Coastal Environment Using Vector Along-Track Interferometry

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The structure of surface currents in the coastal environment can be very complex as it is governed by a multitude of factors such as local bathymetry, sea state, etc.. Knowledge of the structure of coastal currents is a key requirement in the ability to carry out safe maneuvers and landings in an unknown coastal situation. Furthermore, it is often desirable to have the ability to obtain such information by remote sensing and in a timely manner.

We present a remote sensing technique which has the potential to meet these requisites: vector along-track Synthetic Aperture Radar (SAR) interferometry (VATI). Conventional along-track interferometry techniques measure the velocity of scatterers on the ocean surface by measuring the phase difference between two returns from the same surface patch separated by a short time interval. This technique has demonstrated the feasibility of measuring near shore current velocities along the radial direction to the synthetic aperture phase center. The conventional technique has the disadvantage, however, that only one component of the two-component surface current vector is mapped.

In the technique we advocate, we use the finite beamwidth of the transmitting antenna to obtain the angular diversity required to map the two-dimensional velocity vector, at the expense of some spatial resolution. The spatial resolution obtained, however, is great enough to make this technique potentially useful for coastal current monitoring.

We will present a theoretical discussion] of the measurement technique, outlining the scattering mechanism and the relationship between the measured velocity and the surface currents, and its dependence on environmental parameters. To conduct these theoretical studies, we model the scattering process from nonlinear oceans to obtain a simulated instrument signal. We use this signal and our proposed technique to estimate the vec tor velocities, their accuracies, and their relationship to the currents. In particular, the influence of wave motion and wind forcing will be examined. These studies allow us to determine the theoretical accuracy of the technique. Finally, we demonstrate the VATI technique using data acquired by the JPL L-band along track interferometer and compare the results against conventional along-track interferometric measurements.