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Design Specifications of an Incoherent Pulsed Doppler Sonar Instrument for Monitoring Hydrothermal Vent Characteristics

A thesis submitted in partial satisfaction of the requirements for the degree Master of Science in Electrical Engineering (Applied Ocean Science)

by

William Joseph Comeau

Committee in charge:

Professor Victor C. Anderson, Chair
Professor Joseph R. Curray
Professor William S. Hodgkiss

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ABSTRACT OF THE THESIS

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The development of a hydrothermal vent monitor is described. The monitor is proposed to collect data describing the temporal characteristics of black smoker vents such as the temperature and velocity of the venting fluid. The design implements incoherent pulse-to-pulse doppler sonar technology to remotely interrogate the vent area. The instrument must ascertain vent velocities between 1-5 m/sec with a precision of less than 15 cm/sec from a smoker orifice between 2-11 cm in diameter. An autocovariance processing technique is used in computing the velocity estimate. A large number of pulse pairs in the ensemble average, the optimized sampling period, the operating frequency (2.3 Mhz), and the transmit pulse length (120 μsec), contribute to the precision of the velocity estimate. The plan is to operate the instrument in four scanning modes for data collection which are: (1) an overall 3-dimensional profile of the hydrothermal plume velocities and vent structure backscatter amplitudes, (2) an azimuthal doppler scan of plume velocities, (3) an azimuthal thermocouple scan of plume temperatures, and (4) single cell samples at a location of a velocity maximum within the plume. The autonomous instrument package is designed for low power consumption with an operational life of six months. A hardware description of the instrument is also given.

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