MASTER OF SCIENCE
IN
PHYSICS

ACOUSTIC–INDUCED DRAG ON A BUBBLE

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This work reports experiments that show that the drag on a bubble can be modified by the presence of isotropic, homogeneous broadband acoustic noise, when the band overlaps the bubble's resonance width. This constitutes an acoustic analog to the Einstein-Hopf drag on an electromagnetic dipole oscillator in the presence of isotropic and homogeneous electromagnetic fluctuations. In contrast with the electromagnetic Einstein-Hopf drag, band-limited acoustic noise can reduce the drag when the lower frequency of the spectrum coincides with the resonant frequency of the bubble. The modification of the drag experienced by a bubble in the presence of acoustic noise suggests possible applications to bubble migration and to heat transfer in a two-phase fluid. Depending on its size (i.e., resonant frequency), a bubble will experience less or more drag when the fluid is insonified with broadband noise, thereby modifying and possibly controlling bubble migration and heat transfer.

DoD KEY TECHNOLOGY AREA: Other (Physics)

KEYWORDS: Drag, Bubble Dynamics, Analog to Stochastic Electrodynamics

AN INFRARED MODEL OF R/V POINT SUR USING EOPACE DATA

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Infrared polarization techniques to improve the target-background contrast are the subject of much study lately. Polarized infrared images of the research vessel, R/V P*oint* S*ur* were taken extensively during the Electro-Optical Propagation Assessment in Coastal Environment (EOPACE) operational period in March-April 1996 at Point Loma, San Diego. Contrast improvement analysis of these images requires an infrared model of the research vessel.

This thesis models the apparent infrared signature of the R/V P*oint* S*ur* using ship skin temperature records from the EOPACE measurements. Using a simple geometric model and adopting a pixel-by-pixel approach, the emitted radiation for each pixel surface is calculated from the Planck radiation law. Radiation reflected off the pixel surface is estimated using the polarized SeaRad atmospheric propagation code. The total radiance is compensated for atmospheric transmittance with the Navy Aerosol Model to arrive at the apparent radiance at the sensor. The apparent radiance is translated into apparent temperature for comparison with the recorded images to validate the accuracy of the model. There is moderate agreement between the model and recorded images with 45-50% of the pixels falling within 1.75K of the measured apparent temperatures.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Sensors, Modeling and Simulation

KEYWORDS: Infrared, Polarization, R/V P*oint* S*ur*, EOPACE, SeaRad, Navy Aerosol Model