The George W. Woodruff School of Mechanical Engineering

Georgia Institute of Technology

Mechanical Engineering Seminar

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ABSTRACT

Understanding Generation and Mitigation of Underwater Noise from Pile Driving

Environmental risk assessments of impacts from human-generated sound in the ocean are often based on the assumption of a point source; however, most anthropogenic sound sources are extremely different than such an idealized approximation. One example is sound radiation from a large cylindrical pile being driven by an impact hammer into the ocean bottom. Piles of various sizes and materials provide structural support for bridges and piers that pass over water surfaces. Peak sound pressure levels generated underwater by driving large steel piles into the sea bottom can easily exceed 200 dB re 1 µPa at ranges greater than 100 meters. To assess environmental impact and develop effective mitigation measures, a structural acoustics model for a pile being driven by an impact hammer was developed to predict sound radiation. The model determines the modal response of a pile to hammer impact. Contributions from the dominant radiation modes are summed at various ranges to produce a two-dimensional spatial mapping of sound pressure level. The model was implemented in MATLAB® and correlated with measured data. Then the analysis was extended to investigate effectiveness of different mitigation techniques, such as surrounding the pile with a decoupled steel shell or an air bubble curtain. Predicted transmission losses are in good agreement with measured levels reported in the literature. These results indicate that the structural acoustics model and transmission loss analysis provide a viable approach to predict underwater noise produced by pile driving prior to the start of a construction project.

BIO

Mardi Hastings received a B.S. and M.S. in mechanical engineering in 1976 and 1978 from The Ohio State University. She worked over five years in industry before enrolling in the mechanical engineering doctoral program at the Georgia Institute of Technology, where she studied acoustics. In March 1987 she became the first woman in mechanical engineering to receive a Ph.D. at Georgia Tech. Dr. Hastings stayed on as an Assistant Professor of Mechanical Engineering at Georgia Tech until June 1988 when she joined the technical staff at AT&T Bell Laboratories. During the next

two years at Bell Labs she expanded her technical expertise in underwater fiber optic sensor and communication systems. In 1990 Dr. Hastings joined the faculty of mechanical engineering at the Ohio State University, where she advised 30 graduate students and 8 undergraduate honors students over the next 13 years. Her research in acoustics, bioacoustics and fiber optics was funded by the National Science Foundation, Office of Naval Research (ONR), and industry. Prior to joining the Applied Research Lab at Penn State University as a Senior Scientist in Environmental Acoustics, Dr. Hastings was a Program Manager for Marine Mammal Science and Bio-effects of Non-lethal Weapons at ONR 2003-2006. Dr. Hastings has studied auditory mechanics and effects of sound on marine animals for 25 years. She is the author of over 50 journal and proceedings articles, and more than 100 conference papers, seminars, and workshops. She served on the National Academy of Sciences Study Committee on Potential Impacts of Ambient Noise on Marine Mammals, 2001–2002, and received a 2005 Environmental Excellence award from the U.S. Department of Transportation for her work with the California Department of Transportation on the effects of impact pile driving in San Francisco Bay. Dr. Hastings is on the Board of Directors of the Institute of Noise Control Engineering, a Fellow of the Acoustical Society of America (ASA), past chair of the ASA Animal Bioacoustics Technical Committee, and past chair of the ASME Noise Control and Acoustics Division Executive Committee. She enjoys scuba diving, snorkeling, traveling, gardening, reading, and playing the piano.

For more information, please contact the host, Dr. Yves Berthelot 404-385-7646