COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"Empirical Analysis of the Dissipated Acoustic Energy in Wave Breaking"

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Virtual Dissertation

DEPARTMENT:
Ocean & Mechanical Engineering

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ABSTRACT OF DISSERTATION
Empirical Analysis of the Dissipated Acoustic Energy in Wave Breaking

In this research an attempt is made at explaining the physical processes behind energy dissipation during wave breaking, through spectral analysis of the resulting sound. The size of an air bubble can be directly linked to the frequency of the sound that is heard using the simple harmonic solution to the Rayleigh–Plesset equation. It indicates the inverse relationship between frequency and bubble size. And this relationship has been used to identify wave breaking in general [MANASSEH 2006]. Now this research goes a step farther and looks at how the frequency spectrum of the sound changes with time, in an effort to understand the general pattern and from that to deduce an empirical equation that describes the breaking down of turbulence during a wave breaking event.

There have been two main processes identified, with the second process having three main indicators that are necessary to evidence wave breaking. The first process is a near instantaneous shattering of the initial air bubble into much smaller metastable bubbles of a size that is common for all waves independent of wave height. Then in the second process, the bubbles continue to break down following a recognisable pattern.

For the indicators of the continuous movement into higher frequencies (smaller bubble sizes), there has to be a negative phase shift as frequency of the sound increases. Simply said the higher frequencies get more pronounced as time passes. The amplitude decreases with increasing frequency. And finally, there is a sinusoidal pattern to how the power is distributed throughout the frequencies.

It can be concluded from data that the sinusoidal pattern is most likely due to the probability of how bubbles break down. This probability function is not universally constant, but depends on the physical properties of the medium the wave is travelling through, or in the case of ocean waves it depends on the properties of water. Two new parameters are proposed to help describe wave breaking severity.

BIOGRAPHICAL SKETCH
Born in Germany
B.S., Jade Hochschule, Wilhelmshaven, Germany, 2014
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CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2016 - 2020

Qualifying Examination Passed: Fall 2016

Published Papers:

K. Francke, M. Dhanak, and P.-P. Beaujean, “Study of Wave Breaking Through Spectral Analysis of the Dissipated Sound Energy”, in *OCEANS 2019 MTS/IEEE SEATTLE*, Seattle, WA, USA, Oct. 2019, pp. 1–8, doi: 10.23919/OCEANS40490.2019.8962850.

M. Odzer and K. Francke, “Acoustic Study Of Wave-Breaking To Enhance The Understanding Of Wave Physic”’, p. 6, 2020.