A Sound Analysis: An Acoustic and Statistical Investigation of Frequency Patterns in Breaking Waves for Use in Autonomous Vehicle Guidance Applications

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The sound of waves breaking on shore or against an obstruction or jetty is an immediately recognizable sound pattern which could potentially be employed by a sensor system to identify obstructions. If frequency patterns produced by breaking waves can be reproduced and mapped in a laboratory setting, a foundational understanding of the physics behind this process could be established, which could then be employed in sensor development for navigation. This study explores whether wave-breaking frequencies correlate with the physics behind the collapsing of the wave, and whether frequencies of breaking waves recorded in a laboratory tank will follow the same pattern as frequencies produced by ocean waves breaking on a beach. An artificial “beach” was engineered to replicate breaking waves inside a laboratory wave tank. Video and audio recordings of waves breaking in the tank were obtained. Audio of ocean waves breaking on the shoreline was recorded. The audio data was analyzed in frequency charts. The video data was evaluated to correlate bubble sizes to frequencies produced by the waves. The results supported the hypothesis that frequencies produced by breaking waves in the wave tank followed the same pattern as those produced by ocean waves. Analysis utilized the Rayleigh-Plesset relationship (explained in more detail on project board): w_0=√((3yP_0)/p) 1/R_0 which showed that the bubble sizes produced by breaking waves were directly related to the pattern of frequencies. This newly engineered laboratory model enables study of these patterns in a controlled environment with exciting future applications such as in the development of novel marine navigational sensors for use in autonomous underwater vehicles.