Parametric Resonance as Explanation of Mode-locking in Acoustics

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Abstract. Parametric resonance is a selective topic in mechanics with very limited instances of application. Of course, there are case examples of electric circuit and electromagnetic phenomena, mentioned in literature. There are recent reports of identification of occurrence of parametric resonance in acoustics, in the well-known Melde's Experiment and in passage of ultra sonic vibrations in fluid filled cavity. In our attempt to study the acoustics of conch shell, we observed the locking in of sound at odd harmonics of the fundamental and repeated our experiments with cylindrical tubes to confirm the finding. Although mode-locking has been mentioned in classic texts like Philip Morse and N. Fletcher, explanation of the phenomenon looks lacking in literature. Therefore, in this paper we put-forth the theory of parametric resonance as an explanation of this well-known acoustic phenomenon. Vis-à-vis, we present a brief review of the literature to substantiate our stand. Further it is worth pointing out that existence of threshold driving amplitude, as observed in the experiment, ensues as a natural outcome of this formalism.

[Full Paper]