THE UNIVERSITY OF TEXAS AT AUSTIN
Cockrell School of Engineering
Graduate Program in Acoustics

ACOUSTICS SEMINAR

Friday, October 3, 2025, 4:00 p.m. Central Time

Participate in Person: ETC 2.136
Participate via Zoom: https://utexas.zoom.us/j/89499648171

Acoustic Radiation Force: History, Theory, and Recent Advances

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Wave motion often conjures an idea of zero mean action. For example, consider a string of mass density ρ_0 under tension T. At linear order, the string's transverse displacement ξ is described by the wave equation $T(\partial^2\xi/\partial x^2) = \rho_0(\partial^2\xi/\partial t^2)$. The associated momentum density is $\rho_0(\partial\xi/\partial t)$ at leading order, which averages to zero for time-harmonic motion. However, at order ξ^2 the momentum density is $-\rho_0(\partial\xi/\partial t)(\partial\xi/\partial x)$, the time average of which is nonzero. Conservation of momentum at quadratic order therefore leads to *radiation force*, a steady force exerted by waves on objects they encounter. This talk chronicles the history of radiation force, beginning with the observation made by Chinese astronomers in 66 AD that the tail of Halley's Comet points away from the Sun. The contributions of Kepler, Euler, Maxwell, Langevin, Rayleigh, and others are summarized. Parallels are drawn between the momentum conservation equations at quadratic order for waves on a string, surface gravity waves, and acoustic waves in fluids. Expressions for radiation forces exerted on several objects are presented. Unsolved problems related to radiation force are outlined, and potential engineering applications are discussed.