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Experimental determination of the dynamics of an acoustically levitated sphere

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ABSTRACT

Levitation of solids and liquids by ultrasonic standing waves is a promising technique to manipulate materials without contact. When a small particle is introduced in certain areas of a standing wave field, the acoustic radiation force pushes the particle to the pressure node. This movement is followed by oscillations of the levitated particle. Aiming to investigate the particle oscillations in acoustic levitation, this paper presents the experimental and numerical characterization of the dynamic behavior of a levitated sphere. To obtain the experimental response, a small sphere is lifted by the acoustic radiation force. After the sphere lift, it presents a damped oscillatory behavior, which is recorded by a high speed camera. To model this behavior, a mass-spring-damper system is proposed. In this model, the acoustic radiation force that acts on the sphere is theoretically predicted by the Gor'kov theory and the viscous forces are modeled by two damping terms, one term proportional to the square of the velocity and another term proportional to the particle velocity. The proposed model was experimentally verified by using different values of sound pressure amplitude. The comparison between numerical and experimental results shows that the model can accurately describe the oscillatory behavior of the sphere in an acoustic levitator.

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