Developing a New Acoustic Levitation Platform Design for Non-Contact Handling in Electronics Assembly

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In this study, a new acoustic levitation prototype was developed in order to test novel PNP (pick-and-place) machine designs. This new method addresses the issues of conventional designs -their complexity, low speeds, and high cost. The prototype used an installation consisting of 64 emitters and 32 transistors to amplify signals. Both components were placed on a single PCB, utilizing an easier amplifier circuit and new board layout, which allows for lower complexity compared to similar designs. A computer program was used to calculate phases for each individual emitter and send them to the system. Transponders, emitting phase-modulated waves, created a pressure difference above and below a point, “trapping” the particle, and, by calculating phase-shifts using Gorkov's formula, particles could be moved over the platform in 3 directions. After conducting multiple experiments, it has been shown that stable levitation of small particles and electronic components, their precise manipulation (accuracy of 0.05 mm), is possible. This method provides a movement speed of around 50 mm/second and the ability to transport more than 2,000 components per hour. Multi-particle independent stable manipulation has been achieved, allowing for faster speeds. This research shows the possibility of using levitation for new PNP machines.This can reduce production defects, as no need is required for contact with components. A prototype of an acoustic levitation platform was created, which used new techniques to make it cheaper, such as using a single PCB for both amplifiers and transponders and utilizing a simpler amplifier circuit. The next steps should be achieving even faster speed and accuracy by adding more transponders to the system and creating a levitation-based PNP machine prototype.

Awards Won:
Acoustical Society of America: Second Award of $1,000. In addition, their School will be awarded $100, and their Mentor will be awarded $250.