



# Protein Alignment System via Ultrasonic Vibrations (PASUV) Team Good Vibrations



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## Problem Statement

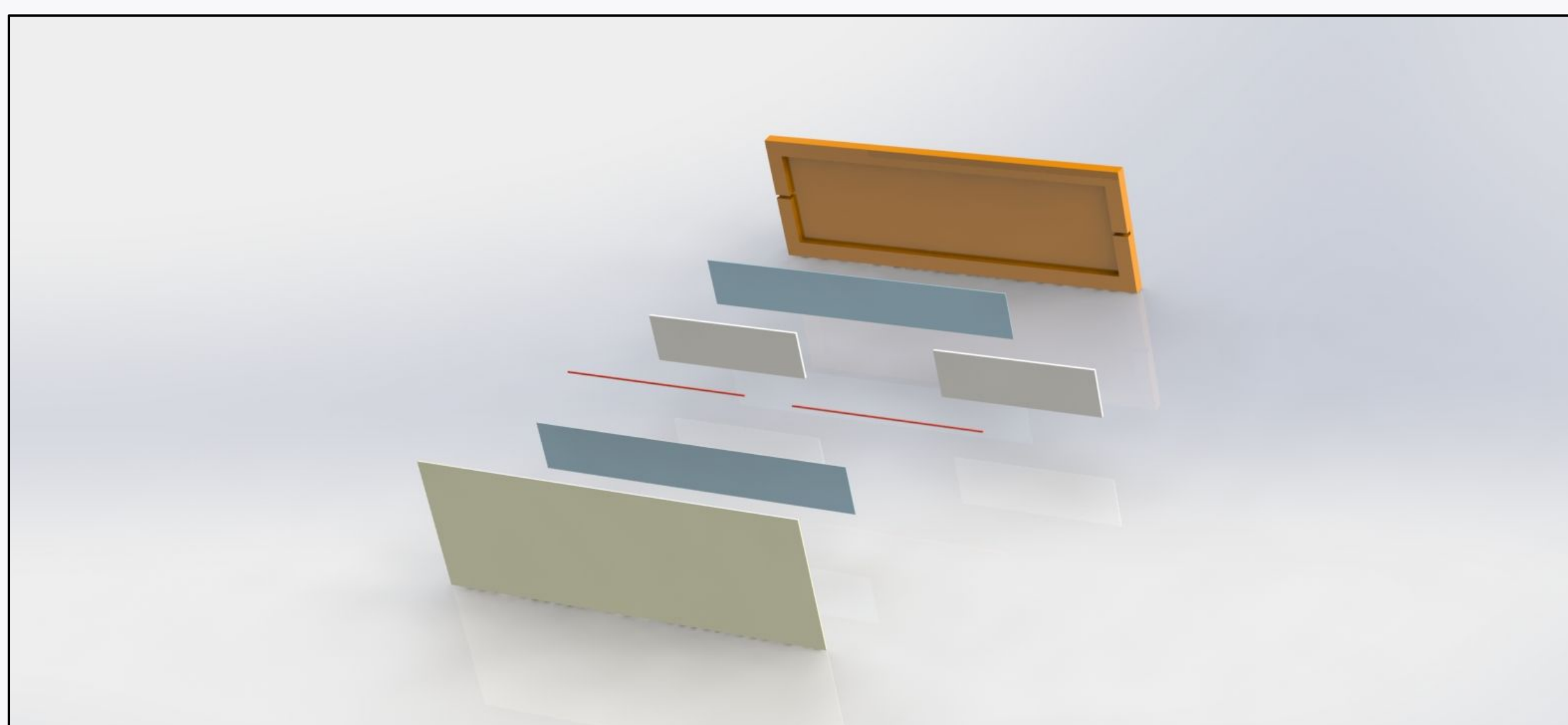
In the field of tissue engineering, tissue may be grown by placing stem cells on biocompatible scaffolding. Some complications in making biocompatible scaffolding is the formation of a three-dimensional structure as well as the accuracy and efficiency in the alignment of the collagen fibers in the scaffolding. Currently a 3-D printing device is being prototyped to address the three-dimensional formation. However, limitations exist in the alignment of the fibers within the scaffolding structure.

## Project Description

Our team has designed a compact ultrasonic transducer to align and pattern the collagen fibers more accurately and efficiently than other competitive processes.

## Transducer Breakdown

The designed transducer consists of a copper housing, PZT plates, silver conductive epoxy, electrodes, and a matching layer. Two 4 MHz PZT plates operating at 200 V are connected by positive electrodes to a voltage amplifier and signal generator. Silver epoxy is used to both hold the transducer components together, and allow electricity to pass from the PZT plates to the grounded, copper housing. The matching layer improves the ultrasound transmission from the PZT plates to the test sample via its quarter-wavelength thickness and optimal impedance value.



## Design

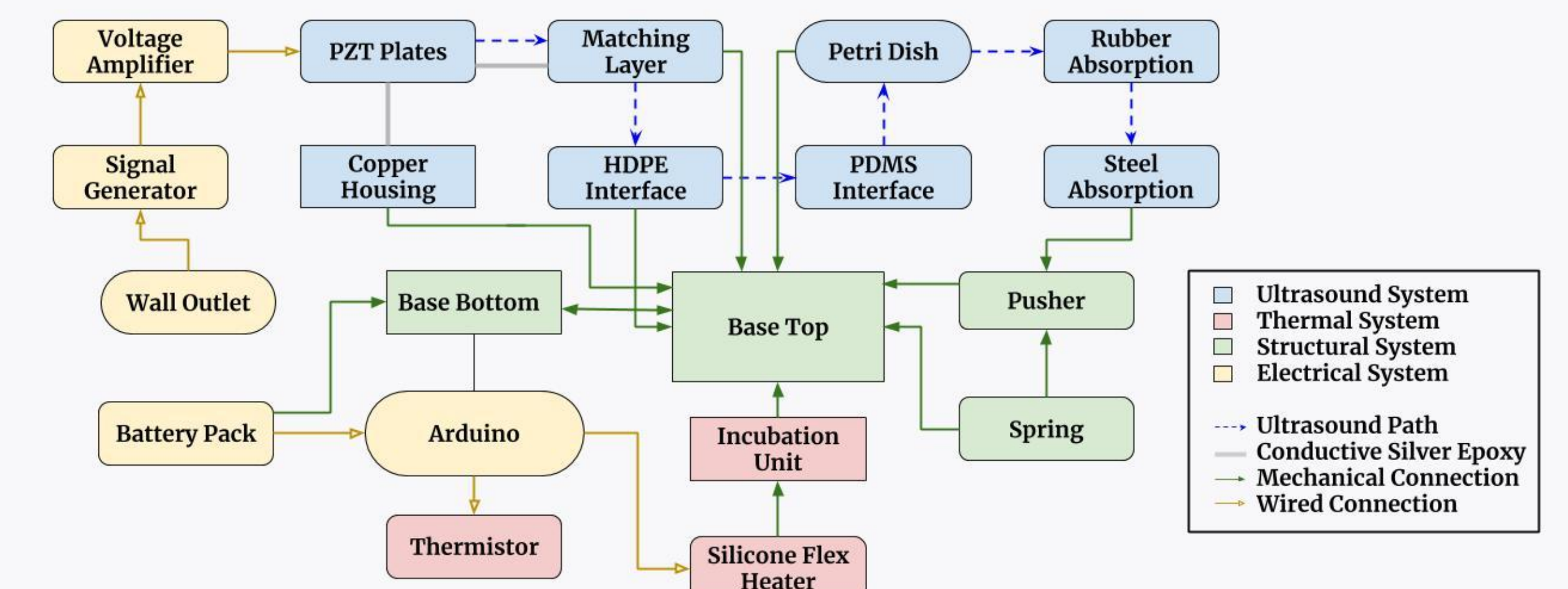


Our 2-part modular design consists of a vibration and incubation unit intended to be used in conjunction with an SLA 3D printer. The base unit serves as a standalone system which includes the ultrasonic transducer, an interface layer of: HDPE and PDMS to help propagate waves, a spring-securing system with a rubber and steel damper, and housing for electronic components. The incubation unit consists of a silicone flex heater and thermistor to monitor incubation temperature, complete with an acrylic housing for insulation and visual monitoring.

## Analysis

The supporting mathematical model was verified within MATLAB. The blocking force, minimum power, and pressure/intensity values throughout the ultrasonic subsystem were all able to be calculated. These calculations were put to the test in COMSOL, wherein the team rendered and modeled the pressure amplitudes throughout the ultrasound path. Further analysis was done on the performance of the PZT plates themselves. Future tests will determine the device's ability to pattern polymer fibers.

## System Level Diagram



## Team



From left to right: Matthew Ariyasu, Kevin Lolly, Nathaniel Schons, Jordan Lee

## Acknowledgements

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