
Master Thesis Project, 2022-2023

— Ultrasonic Skin Model —

Supervisor: Frédéric GIRAUD frederic.giraud@univ-lille.fr, L2EP – Univ. Lille

Christophe GIRAUD-AUDINE christophe.giraud-audine@ensam.eu, L2EP – ENSAM Lille

Context

Characterizing the mechanical behaviour of the superficial layers of skin is essential to assess its health, and thus anticipate skin diseases or alteration. This is the core of the European project H2020 Stints, in which the L2EP is a beneficiary. The purpose is to propose a diagnostic tool that is based on the ultrasonic deformation of the skin, and to measure the fundamental of the interaction force.

To operate, the tool is built on a piezoelectric actuator. Interestingly, the electrical energy conversion that operates in the actuator is derived to observe and monitor the fundamental interaction force. How the skin reacts to ultrasonic deformation is helpful to assess its health.

In this project, we want to go beyond the measure, and to propose the mechanical model that describes the interaction of the skin with the ultrasonic deformation, including the electrical energy conversion.

Objective

After a literature review of skin mechanical models, a model will be proposed into Matlab/Simulink. This model will be validated with experimental measurements carried out on an existing device.

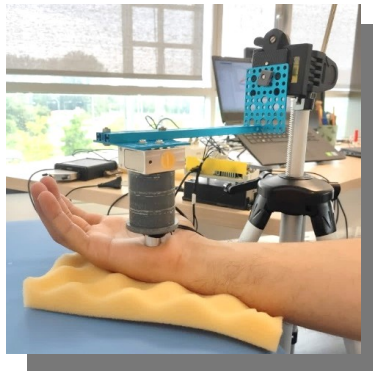


Figure 1: Ultrasonic skin health assessment tool

Key word

Ultrasonic, Piezoelectric, Mechatronic

References

- [1] *PCA Model of Fundamental Acoustic Finger Force for Out-of-Plane Ultrasonic Vibration and its Correlation with Friction Reduction* IEEE Transactions on Haptics, TORRES GUZMAN Diana Angelica, KACI Anis, GIRAUD Frédéric, GIRAUD-AUDINE Christophe, AMBERG Michel, CLENET Stéphane, LEMAIRE-SEMAIL Betty
- [2] E. M. Sales de Castro, F. Giraud, B. Lemaire-Semail and M. Amberg, "Vector Controlled Ultrasonic Transducer Applied to Soft Material Mechanical Impedance Estimation," 2021 IEEE International Workshop of Electronics, Control, Measurement, Signals and their application to Mechatronics (ECMSM), 2021, pp. 1-5, doi: 10.1109/ECMSM51310.2021.9468870.