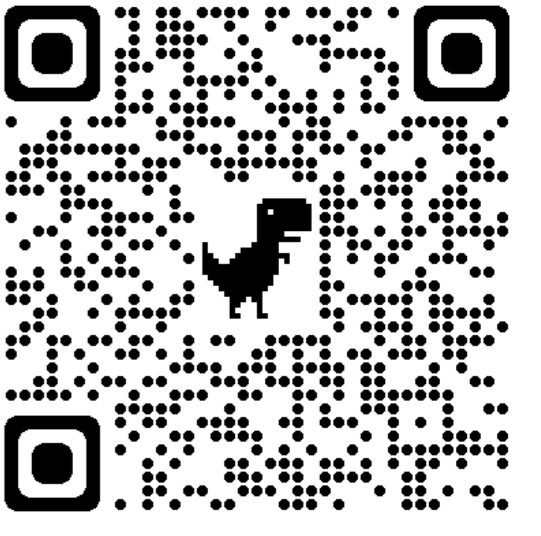# HACETTEPE UNIVERSITY
Department of Electrical and Electronics Engineering
Development of a Cell Stretching Bioreactor with Closed-Loop Force Control

Sinan VARGELOĞLU - 21428556
Supervisors: Dr. İsmail UYANIK, Dr. Şölen K. YILDIZ

Why Do We Need Cell Stretching Bioreactor?

The Cell Stretching Bioreactor device is a user-controlled bioreactor that applies cyclic or static stretching to cultured cells. It is designed to help researchers analyze biochemical changes in response to stretching load in a variety of cell culture applications such as muscle, lung, heart, vessel, skin, tendon, ligament, cartilage. Our cell stretching bioreactor system is used to stimulate cells in cell culture using mechanical strain. Our system is specifically designed for skeletal muscle cells (Limb-girdle type 2-R) as a TUBITAK project.
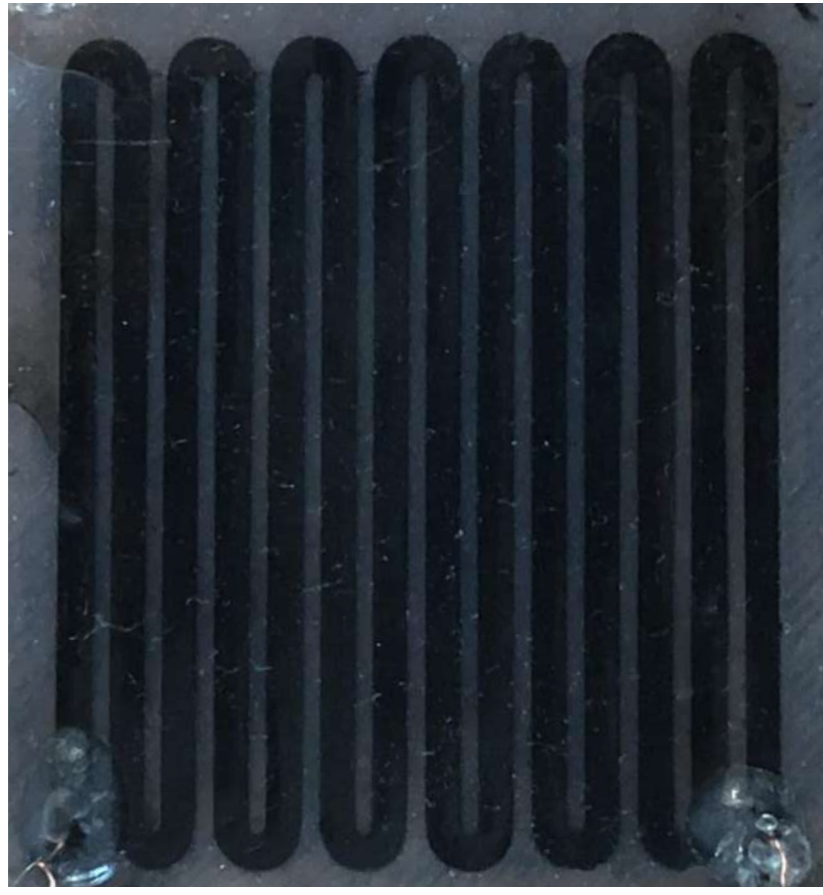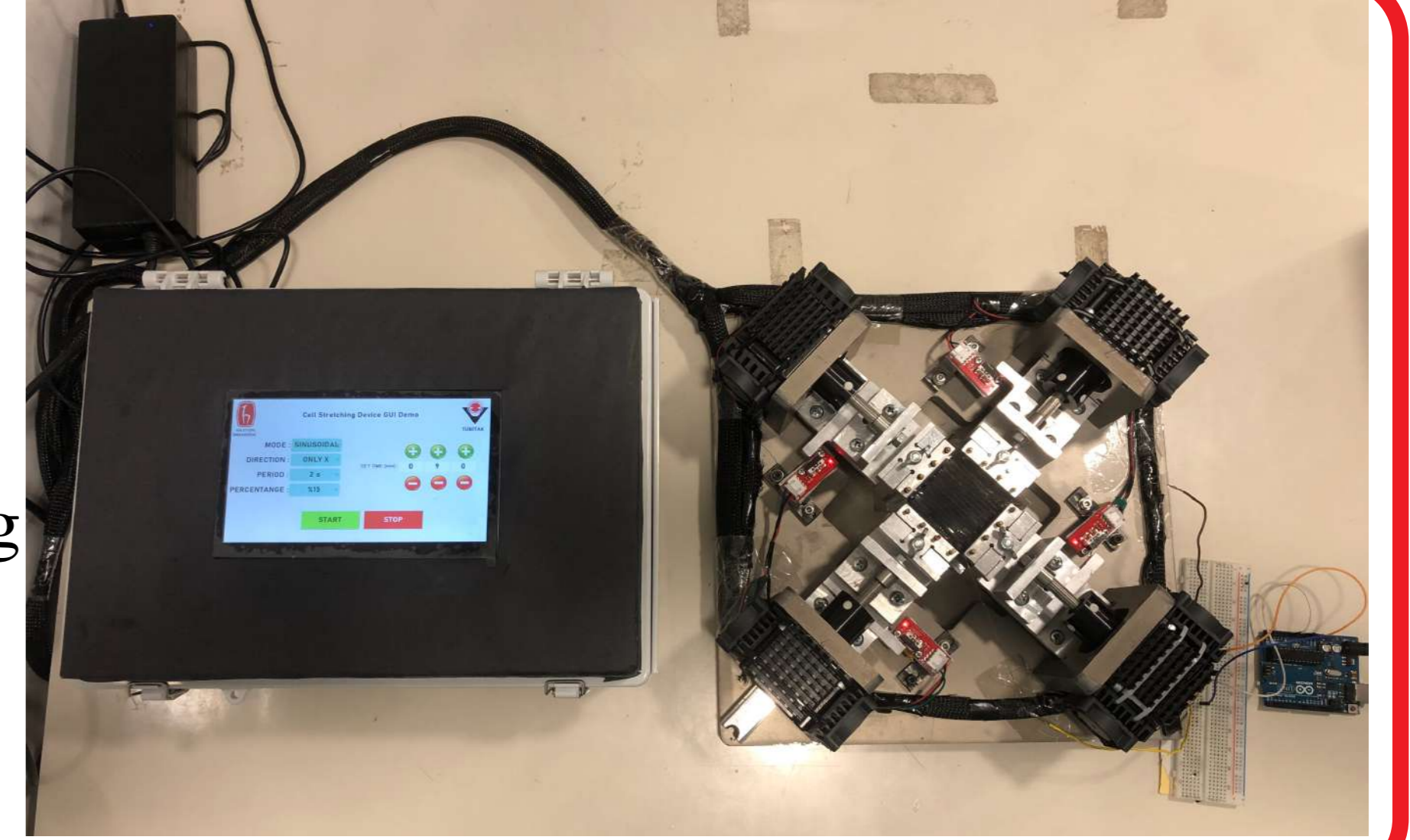

Why Do We Prefer Stretchable Soft Sensors?

Stretchable soft sensors can stretch, flex and detect very low impacts. For this reason, very precise measurements can be taken. It can be used for the pressure to be applied by the robot arm, in areas where sensitive handling is required or to control the stretching like our project.
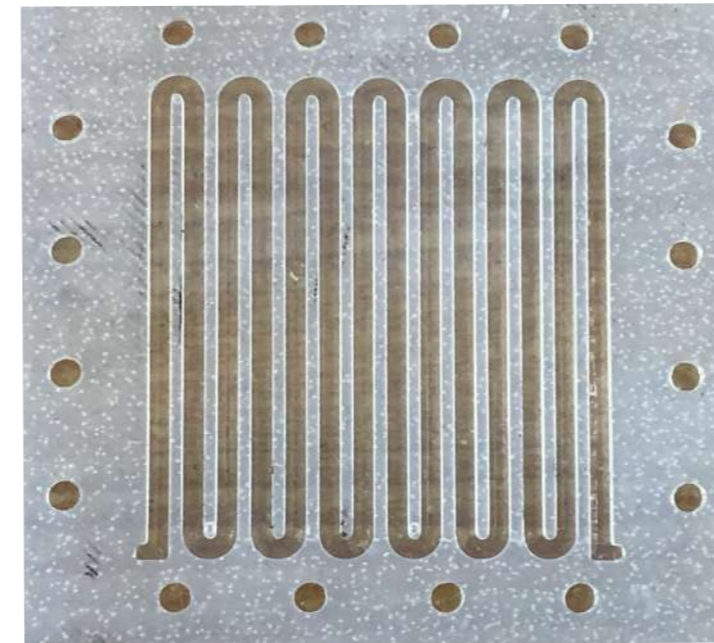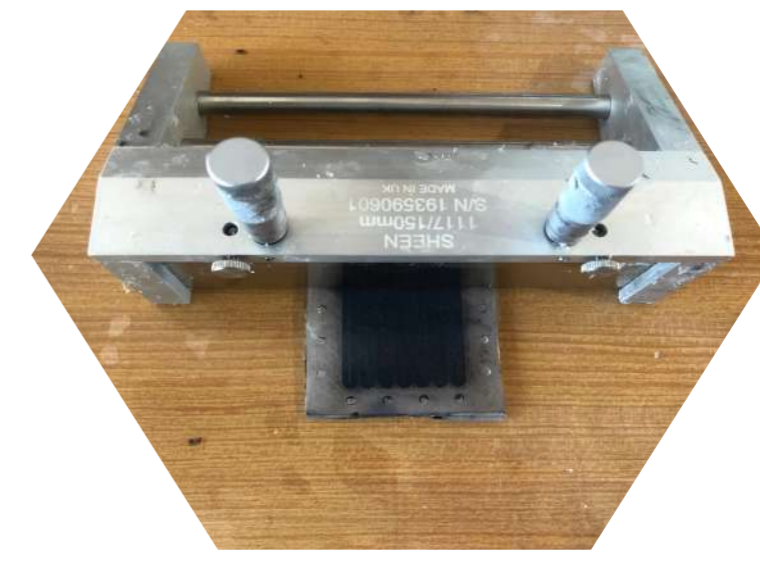
Sensor Production
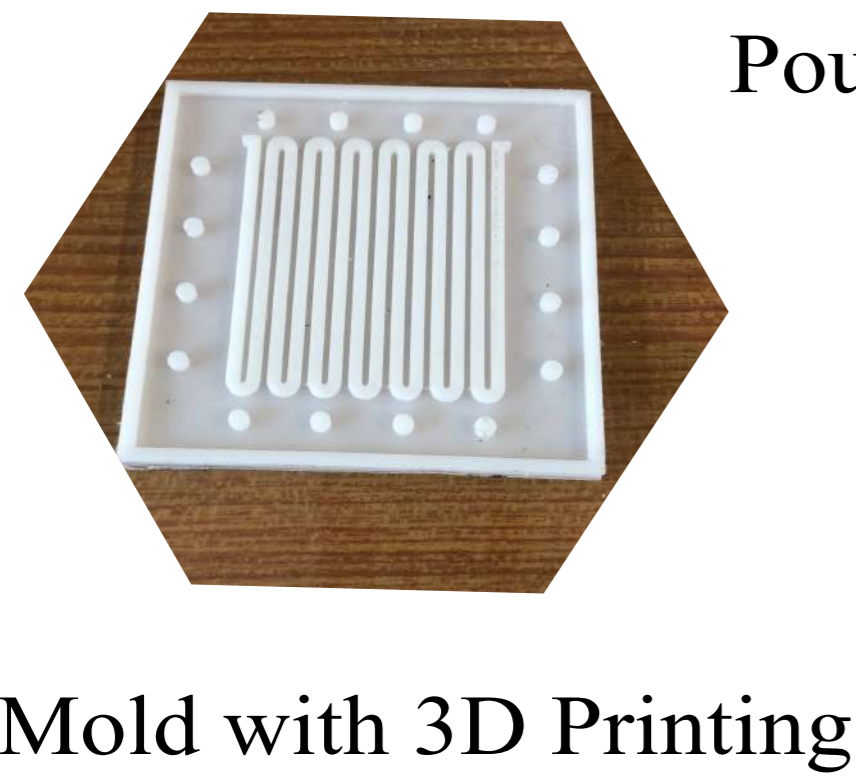
Mold with 3D Printing

Pouring Silicone into Mold
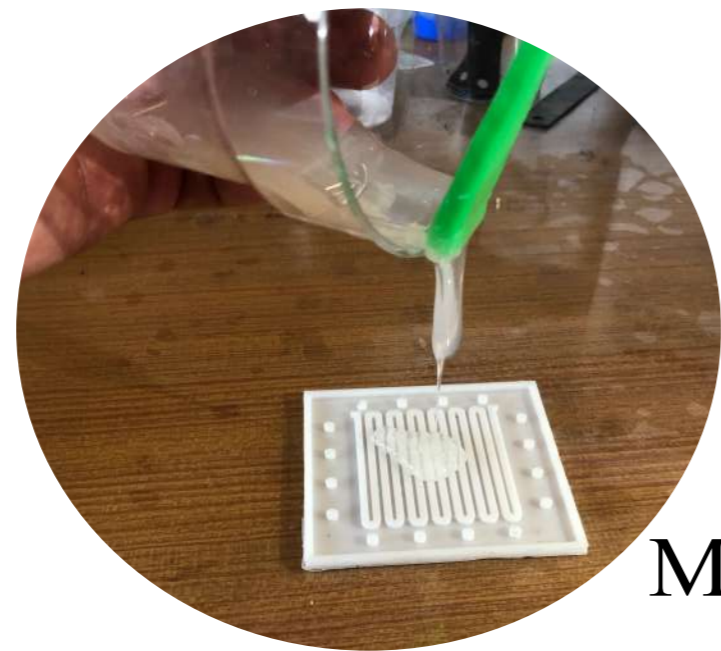
Main Part Releases From Mold

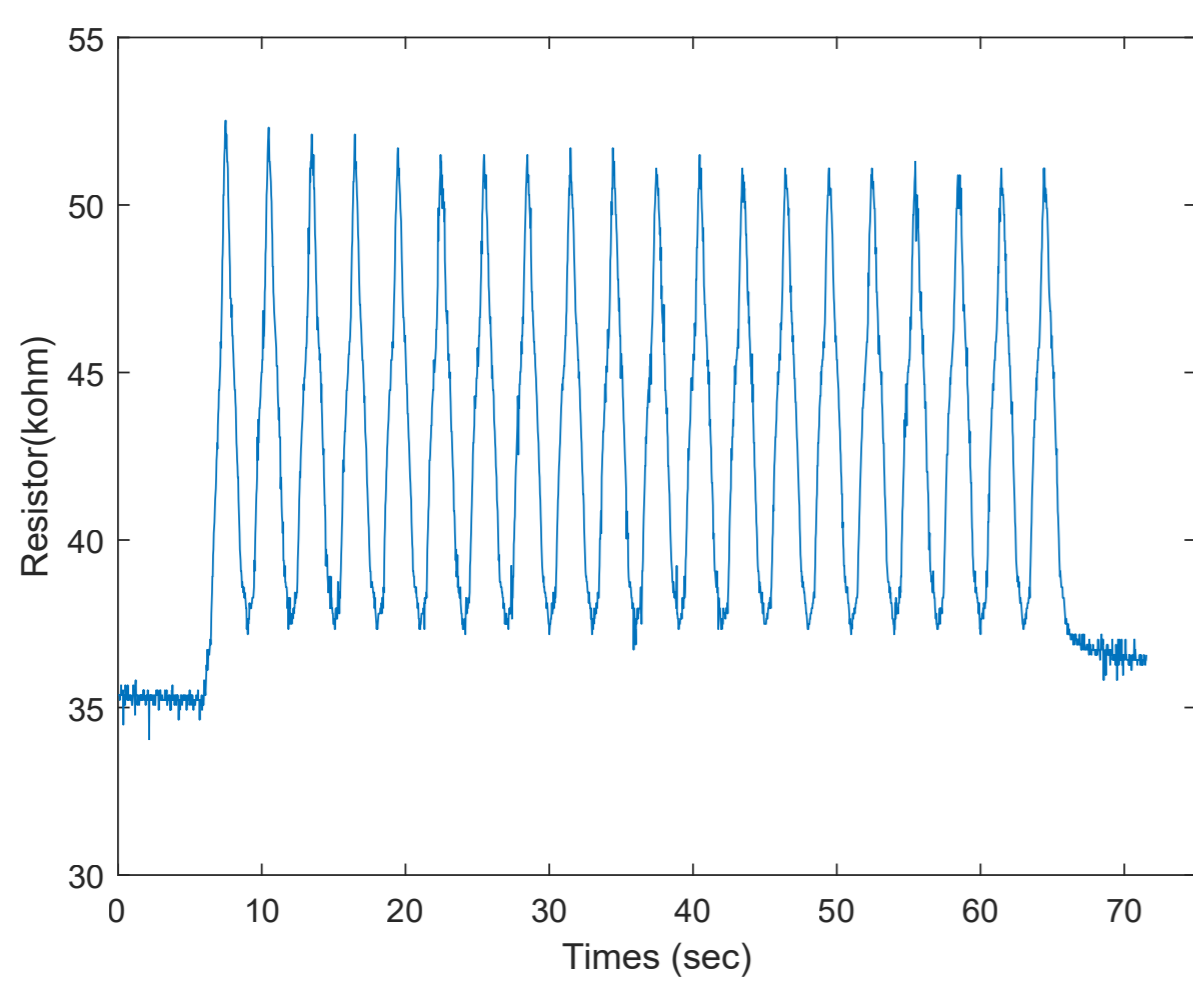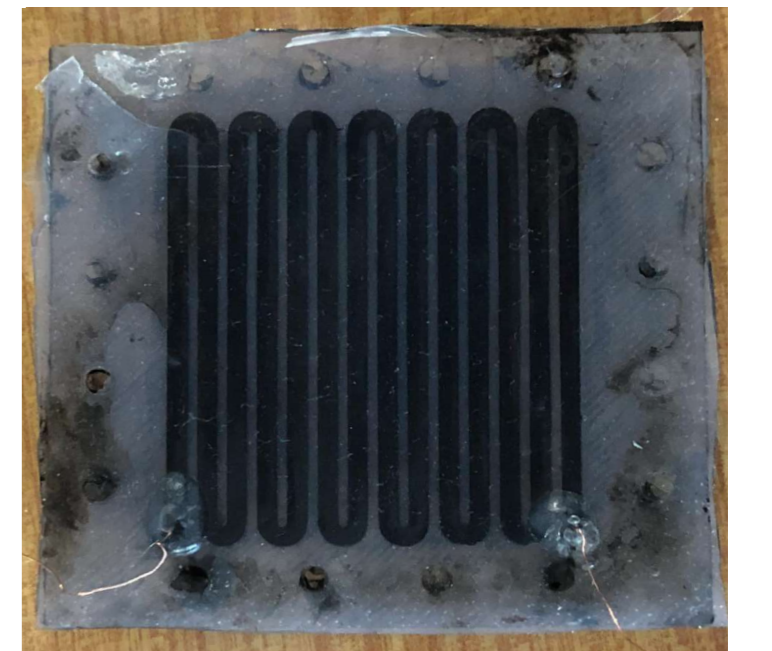Grease Filling

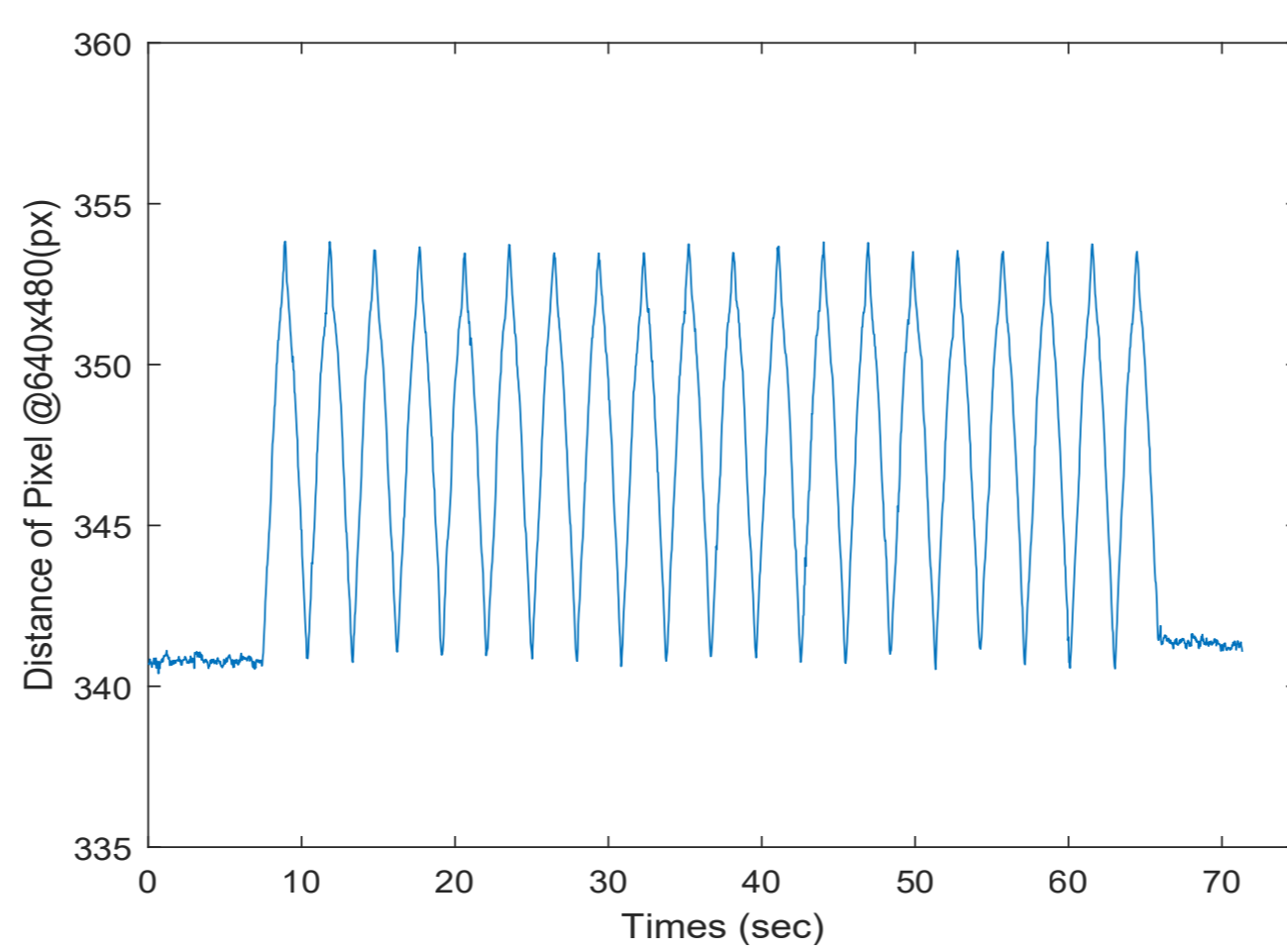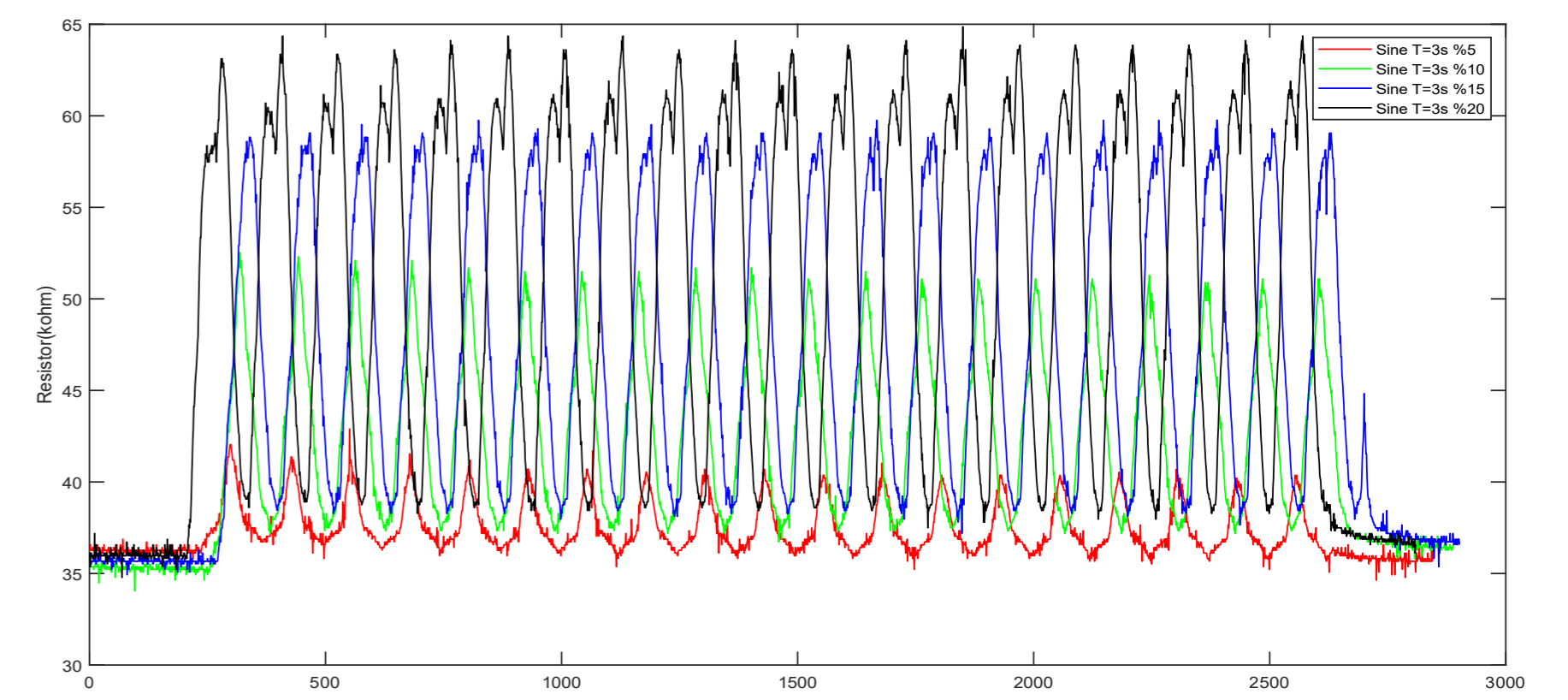Covering with Silicone

Silicone Ready to Use

Soft Sensor Characterization

Sensor Data Sine Wave T=3 10% Stretch

Camera Data T=3 10% Stretch

Sensor Data Sine Wave T=3 All Stretch

Conclusion

The bode plot of the sensor and camera data is given. The delay in the camera image is visible. This is because the camera renders with some delay.

It can be used to complete the loop in a closed loop control system. Since the motors in the system do not have encoders, full integration can be achieved with a professional production study.