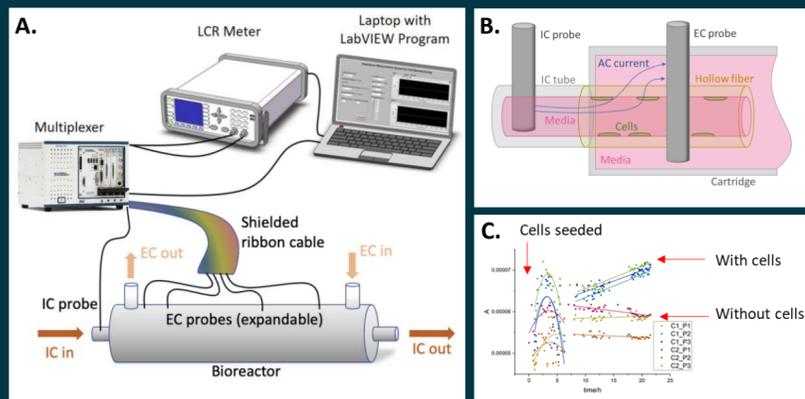


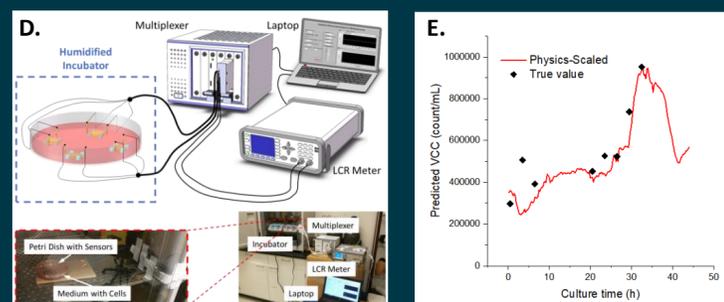
Cell Density Sensing

Cell Density Sensing for Hollow Fiber Bioreactors



A. The schematic for cell density sensing system and the bioreactor integration. EC probes are inserted in the cartridge, while the IC probe is inserted at the IC inlet/outlet. **B.** The probes detect the hollow fiber wall's impedance, which reflects the cell density. **C.** Parameter A can serve as an indicator of cell density in the hollow fibers.

Cell Density Sensing for Floating Cell Cultures



D. Biocompatible sensors are embedded in the petri dish throughout the cell culturing process. The impedance data over 15 frequencies are collected using a precision LCR meter. **E.** First, features are extracted from the collected data using a novel equivalent circuit model. Then, selected features predict the viable cell count (VCC) via a physics-based model. The figure compares the predicted values to the true values.

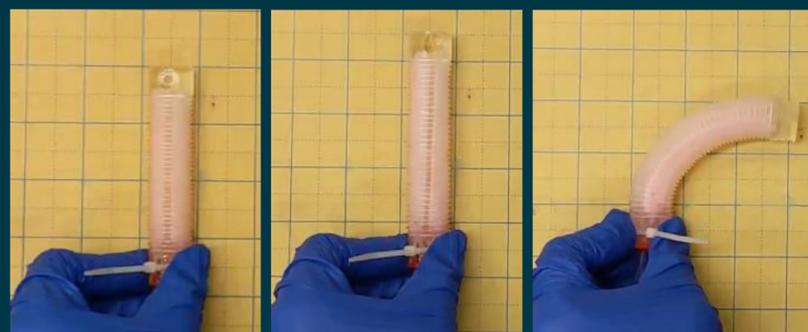
3D Printed Soft Robot

Polyjet 3D printer and printed soft actuator



Polyjet 3D printing technology has the capability to print parts with gradient hardness. This capability is very promising in soft robot manufacturing, granting more possibilities in the robot functionalities.

Elongation and bending capabilities



The soft actuators in the figures are made with Agilus30, a printable soft material with hardness as low as 30 Shore A. Although this material is not as strong as most soft materials for molding, it is sufficient for soft robot applications with proper reinforcement. The soft actuator in the figures above is strengthened with strain wrapping.

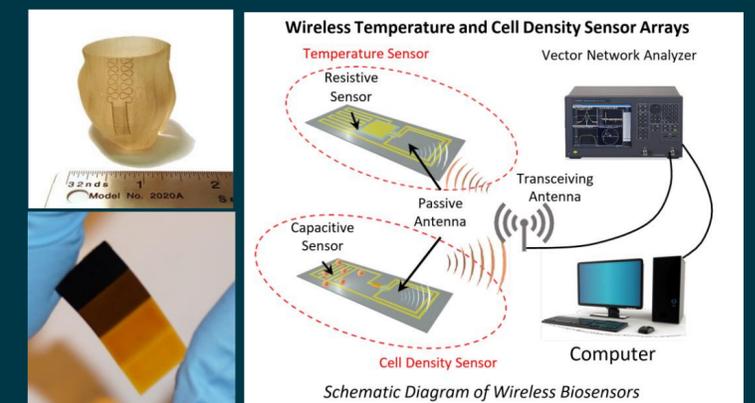
Aerosol Jet Printing

Process

Aerosol Jet printing technology has the capability to print a variety of materials including conductive materials, piezoelectric materials, and polymers. It can also print on uneven substrates.



Applications



Our lab has explored many applications using the Aerosol Jet printer:

- Strain sensing
- Cell density sensing
- Thin films with tunable stiffness
- Ammonia gas sensing