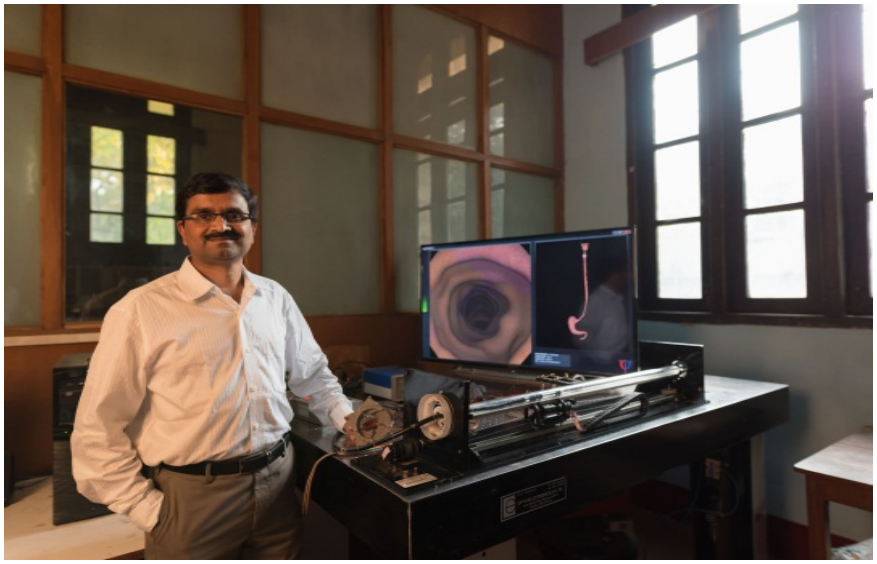
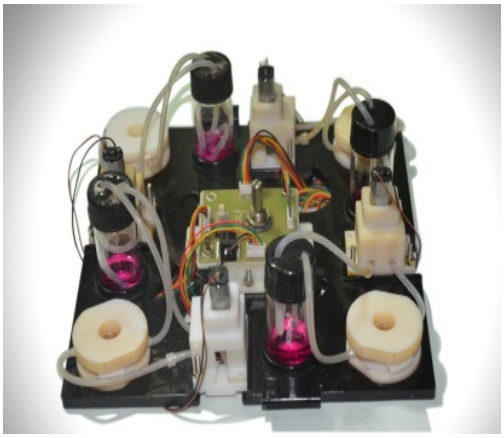
GK ANANTHASURESH (Chair, Centre for BioSystems Science and Engineering)

A HIGH-THROUGHPUT DEVICE FOR CELL CULTURE



GK Ananthasuresh and his team investigate the mechanical response of biological cells to biochemical and physical stimuli. As part of their research, they have developed a miniature bioreactor system that mimics *in vivo* conditions in cell culture.* The custom-designed system, comprising bioreactors and peristaltic pumps, enables high-magnification live microscopy and microbiology experiments.

This bioreactor system has many novel features: It can accommodate scaffolds that alter the microenvironment of cells; its modular construction enables it to be reconfigured for a variety of studies; it is reusable because all its components can be sterilized; and it can be used as a Petri dish in standard incubators.



Perfusion bioreactor that can accommodate scaffolds on cover-slips with provision for high magnification in situ

Ananthasuresh, a mechanical engineer by training, is excited about the potential of their novel device. “It allows for long-term pulsatile flow on cells similar to what they experience *in vivo*. The constant flow of medium improves nutrient and oxygen delivery and minimizes waste accumulation, enabling extended use,” he says.

Using principles of mechanics, Ananthasuresh and his students, in collaboration with biologists and clinicians, are developing scalable miniature tools and computational techniques for quantifying mechanical response of single cells

The bioreactor system is also helping bring researchers from different fields together. For instance, Ananthasuresh's team is collaborating with Saumitra Das (Professor, Department of Microbiology and Cell Biology), to probe the mechanism of Hepatitis C virus infection in liver cells by correlating mechanical and biochemical measurements. "With our technique, results similar to the conventional culture method could be achieved with only a few cells and faster turnaround," Ananthasuresh says, highlighting its potential in biomedical research. What's more, the device can be used to test multiple drugs, reducing reliance on animal models.To reach out to the broader R&D community, two of his former students have started a company—*Bendflex*—to market the bioreactor system and ultrasensitive force sensors.

The development of the bioreactor will contribute towards establishing mechanical markers of diseases with the larger goal of inventing next-generation medical diagnostics called *mechano-diagnostics*. This entails understanding the effect of diseases on the mechanical properties of individual cells, development of miniature tools for point-of-care measurement of mechanical responses, and computational techniques for associating diseases to the measured responseswith specificity.

* S Balakrishnan, MS Suma, SR Raju, SDB Bhargav, S Arunima, S Das and GK Ananthasuresh. 2015. A scalable perfusion culture system with miniature peristaltic pumps for live-cell imaging assays with provision for microfabricated scaffolds.*BioResearch Open Access*, 4(1):343–357.