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Telehaptic 3D Biomanipulation workstation for mechanical interactions with microstructures

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Abstract

The ability to operate on cells safely and efficiently using repeatable techniques is increasingly important to a number of fields such as biotechnology, pharmacology, agriculture, oncology, genetics, neuroscience and embryology. In our ERC-AdG (European Research Council Advanced Grant) project, we have demonstrated a bio-manipulation system that enables the user to touch, manipulate and assemble individual algae cells and polystyrene beads, almost as naturally as we handle objects in our macroscopic world. This setup consists of a MEMS-based microgripper with integrated force sensor, piezo-positioners, Phantom haptic device and a stereo microscope. By integrating these devices to create an appropriate multimodal interface, the position, opening and force of the gripper can be displayed and controlled intuitively in real time. Altogether, this allows the user to uniquely touch and feel cellular forces, helping to perform tasks such as micro-injections, biopsies and tool-to-cell interactions with greater control, ease and efficiency. To leverage higher optical resolutions, we have also extended our biomanipulation systems to be compatible for compound, SIM and confocal microscopy. Further, by using haptic technology and robotic techniques, automation of certain cell manipulation tasks is also possible. Unlike other setups, this new technology provides the user the ability to capture the mechanical properties of cells at a micron scale which is thought to be of value to a variety of domains. To demonstrate the potential impact of this work, we have started by performing fundamental investigations on the biomechanics and neuroscience of touch.

Biography

Dr. Vijay Pawar has a PhD from University College London (UCL). He has expertise in haptic 3D interfaces, multimodal interface design and micro-nano biomanipulation. He is project manager of the UCL TouchLab. Andreas Schmid is a doctoral candidate funded by an ERC Advanced Grant in this robotics laboratory lead by Prof. Mandayam Srinivasan who is also founder and Director of the MIT TouchLab.

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