Microscope developed at MBL tracks individual molecules in living cells

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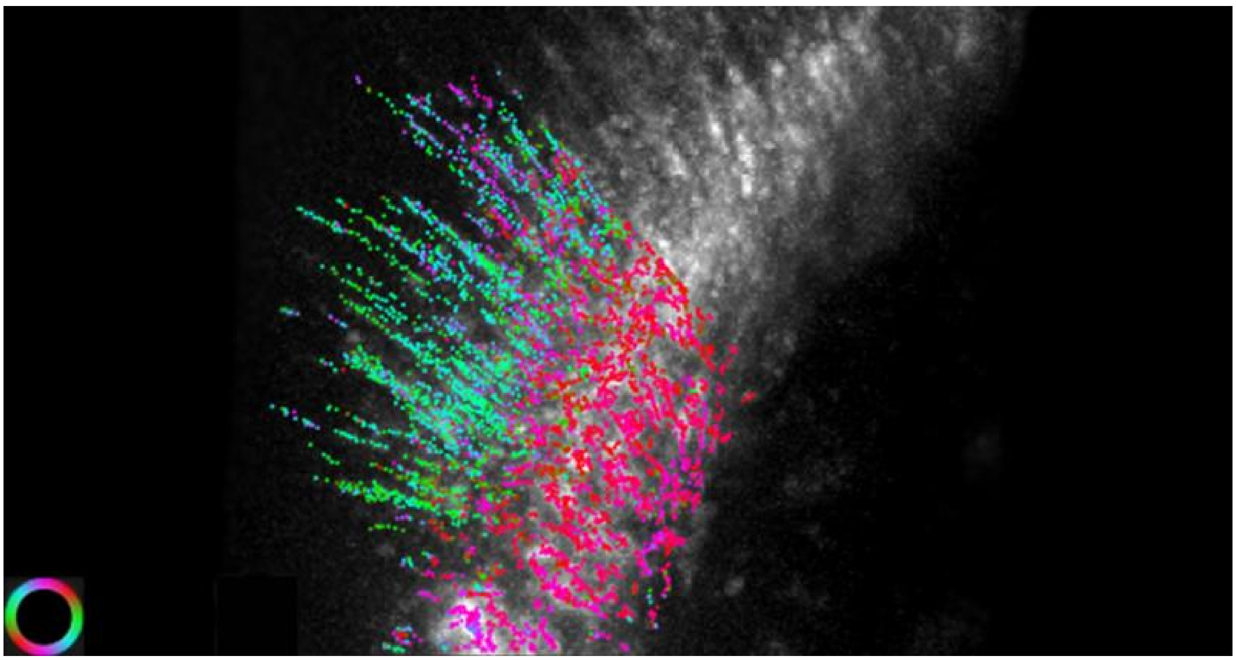

New microscope shows the actin filament orientation in human skin cells, corresponding to the color wheel at bottom left. Credit: Shalin Mehta and Tomomi Tani

Scientists at the Marine Biological Laboratory and colleagues have unveiled a new microscope that can track the position and orientation of individual molecules in living cells—nanoscale measurements that until now have posed a significant challenge.

As reported this week in the *Proceedings of National Academy of Sciences*, the team's "instantaneous fluorescence polarization" microscope offers new insights into how cells achieve directed functions or forces.

"All functions of cells are directed. For example, cells move in a specific direction or divide at a certain site and orientation so the two daughter cells are the right size. That direction comes from the nanoscale alignment of molecules in the cells, which this microscope can detect," said lead author Shalin Mehta, staff scientist in the University of Chicago's Department of Radiology and a staff researcher at MBL.

Understanding how cellular components work requires peering at a nanoscale—to the activity of billionth-of-a-meter-sized molecules that assemble to form the cell's components and drive their functions.

"With this microscope, we can see the orientation of a single molecule, or an assembly of molecules as they form a higher-order structure," said co-author Tomomi Tani, an MBL associate scientist. The scope can also detect minute conformational changes that are required for the protein's function.

Polarized light microscopes, iterations of which been developed at the MBL since the 1950s, exploit "a property of light not visible to the human eye to measure molecular order below the resolution limit of the microscope," Mehta explained.

The team used the microscope to address various biological questions in collaboration with other scientists at the MBL, including Amy Gladfelter of University of North Carolina, Chapel Hill, and Clare Waterman of the National Institutes of Health.

"That is a unique feature of being at the MBL," Mehta said. "We were able to study three biological questions while our method was under development. Trying to solve each question led us to improve the microscope and the algorithms with every iteration."

More information: Shalin B. Mehta et al. Dissection of molecular assembly dynamics by tracking orientation and position of single molecules in live cells, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1607674113

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