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Particle Tracking Velocimetry of Microalgal Response to Light

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ABSTRACT

Phototaxis is the directed movement of organisms in response to light stimuli, allowing them to seek optimal illumination for growth and energy acquisition. Despite its biological significance, clear and quantitative tracking of microalgae reactions to light has not been reported. In this study, particle tracking velocimetry (PTV) is used to directly track motile microalgae and measure their velocity changes under varying light wavelength and intensities. This approach allows us to correlate the phototactic response with specific light conditions, offering new insights into the underlying biophysical mechanisms governing microalgal behavior.

To reach this goal, the experiments were conducted within a sealed glass channel, with both ends securely closed to ensure controlled conditions. An LED light source, delivered via an optical fiber, was positioned at one end of the channel to induce phototaxis. High-speed imaging at elevated frame rates allowed for precise capture of *Chlamydomonas reinhardtii* CPCC 532 movement, and the PIVlab software was used to extract velocity information from successive frames. A range of experimental parameters was explored, including variations in light intensity, and the influence of microalgal culture age. The collected data enabled us to correlate the velocity of the strain with the intensity of the light stimulus.

Our findings demonstrate that the direct tracking of microalgae via PTV provides a robust method for quantifying their behavioral responses to environmental stimuli. This method not only confirms the accuracy of using PTV in lieu of traditional particle-image-velocimetry (PIV) in scenarios lacking additional seeding but also lays a groundwork for future studies aimed at understanding the adaptive mechanisms of micro swimmers in response to light.