Novel technique to simultaneously image flagellar beat in 3D and Ca$^{2+}$ concentration

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Successful fertilization depends on the ability of sperm to locate the egg. Sperm use their flagellum as antenna to detect chemical substances released by the egg. These substances are transduced by the cell into changes of the flagellar beat that propel sperm towards the egg - a process called chemotaxis.

To understand how this bio-machine works, we want to characterize the flagellar beat in 3-dimensions. Here, we present a novel technique to image four focal planes simultaneously at 500 frames per second.

With this technique, we studied sperm of the sea urchin *Arbacia punctulata* while swimming in a gradient of chemoattractant. In *Arbacia punctulata*, periodic movement of sperm in a chemoattractant gradient induces oscillations of the intracellular Ca$^{2+}$ concentration ([Ca$^{2+}$]) that lead to periodic modulation of the flagellar beat. However, the precise relationship between the flagellar waveform and the Ca$^{2+}$ concentration along the flagellum remains unknown. Therefore, we built a setup to image simultaneously the [Ca$^{2+}$], and the flagellar beat of sperm with up to 300 frames per second. Here, we present preliminary results of our work.