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Regularized Stokeslet representations for the flow around a human sperm KENTA ISHIMOTO, Kyoto University, HERMES GADELHA, University of York, EAMONN GAFFNEY, University of Oxford, DAVID SMITH, JACKSON KIRKMAN-BROWN, University of Birmingham — The sperm flagellum does not simply push the sperm. We have established a new theoretical scheme for the dimensional reduction of swimming sperm dynamics, via high-frame-rate digital microscopy of a swimming human sperm cell. This has allowed the reconstruction of the flagellar waveform as a limit cycle in a phase space of PCA modes. With this waveform, boundary element numerical simulation has successfully captured fine-scale sperm swimming trajectories. Further analyses on the flow field around the cell has also demonstrated a pusher-type time-averaged flow, though the instantaneous flow field can temporarily vary in a more complicated manner - even pulling the sperm. Applying PCA to the flow field, we have further found that a small number of PCA modes explain the temporal patterns of the flow, whose core features are well approximated by a few regularized Stokeslets. Such representations provide a methodology for coarse-graining the time-dependent flow around a human sperm and other flagellar microorganisms for use in developing population level models that retain individual cell dynamics. Reference: K. Ishimoto et al., PRL, 118 (2017) 124501.

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