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Squirmers with swirl: a model for *Volvox* swimming TIMOTHY PEDLEY, University of Cambridge, DOUGLAS BRUMLEY, M.I.T., TAKUJI ISHIKAWA, Tohoku University — A *Volvox* colony takes the form of a perfect sphere that swims because each cell on its surface has a pair of beating flagella. The flagella of the different cells are coordinated, almost certainly hydrodynamically [1], to beat approximately in a meridional plane, with axis of symmetry in the swimming direction, but with a roughly 10 degree azimuthal offset which means that the colonies rotate about their axes as they swim. Experiments on colonies held stationary on a micropipette show that the beating pattern takes the form of a symplectic metachronal wave [1]. Here we extend the Lighthill/Blake axisymmetric, Stokes-flow model of a free-swimming spherical squirmer to include azimuthal swirl. The kinematics of the metachronal wave are used to calculate the coefficients in the eigenfunction expansion and hence calculate the swimming speed and rotation rate (proportional to the square of the beating amplitude); measuring these provides a simple means of assessment of the flagellar beating parameters of individual colonies. Extension of the model to include colony interactions, with each other and a plane boundary, leads to simulations of Volvox "dancing": the observed bound states of ref [2].

[1] D.R. Brumley et al, Phys. Rev. Lett., 109:268102,2012
[2] K. Drescher et al, Phys. Rev. Lett., 102:168101,2009

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