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Resistive force theory for sand swimming YANG DING, School of Physics, Georgia Tech, RYAN MALADEN, Bioengineering Program, Georgia Tech, CHEN LI, DANIEL GOLDMAN, School of Physics, Georgia Tech — We discuss a resistive force theory [1] that predicts the ratio of forward speed to wave speed (wave efficiency, η) of the sandfish lizard as it swims in granular media of varying volume fraction ϕ using a sinusoidal traveling wave body motion. In experiment $\eta \approx 0.5$ independent of ϕ and is intermediate between $\eta \approx 0.2$ for low Re Newtonian fluid undulatory swimmers like nematodes and $\eta \approx 0.9$ for undulatory locomotion on a deformable surface. To predict η in granular media, we developed a resistive force model which balances thrust and drag force over the animal profile. We approximate the drag forces by measuring the force on a cylinder (a "segment" of the sandfish) oriented at different angles relative to the displacement direction. The model correctly predicts that η is independent of ϕ because the ratio of thrust to drag is independent of ϕ. The thrust component of the drag force is relatively larger in granular media than in low Re fluids, which explains why η in frictional granular media is greater than in viscous fluids.

[1]Maladen et. al, Science, **325**, 314, 2009

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