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How does muscle forcing lead to translational motion in undulatory swimming?[1] AMNEET BHALLA, NEELESH PATANKAR, Northwestern University — Swimming organisms show variety of complex deformations during their movement. In this work we enquire whether complex muscle forcing is required to create the observed deformation kinematics that cause movement. We interrogate how the muscle forcing leads to the forward translational momentum of an organism. A set of linearized equations of motion, using a spring-link model, is derived for undulatory swimming. We do not consider observed body deformations to be composed of active and passive components. Instead, swimming is treated as a forced oscillation problem. Forcing can be due to the muscles (active swimming) or due to the surrounding fluid (passive swimming). In either case, the forcing triggers the first few fundamental deformation modes of the body which in turn drive the axial translational motion. We explain the reason for observing only the first few fundamental modes. It is seen that simple forcing patterns can trigger complex looking deformation kinematics that lead to movement. We show that there is range of frequency at which the body responds well (i.e. the swimming speed increases with frequency), but after that range the body does not respond well to higher frequencies. It is found, consistent with prior work, that anisotropy in drag enables swimming.

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