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Natural descriptions of motor behavior: examples from *E. coli* and *C. elegans*.

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E. coli has a natural behavioral variable - the direction of rotation of its flagellar rotorary motor. Monitoring this one-dimensional behavioral response in reaction to chemical perturbation has been instrumental in the understanding of how *E. coli* performs chemotaxis at the genetic, physiological, and computational level. Here we apply this experimental strategy to the study of bacterial thermotaxis - a sensory mode that is less well understood. We investigate bacterial thermosensation by studying the motor response of single cells subjected to impulses of heat produced by an IR laser. A simple temperature dependent modification to an existing chemotaxis model can explain the observed temperature response. Higher organisms may have a more complicated behavioral response due to the simple fact that their motions have more degrees of freedom. Here we provide a principled analysis of motor behavior of such an organism – the roundworm *C. elegans*. Using tracking video-microscopy we capture a worm's image and extract the skeleton of the shape as a head-to-tail ordered collection of tangent angles sampled along the curve. Applying principal components analysis we show that the space of shapes is remarkably low dimensional, with four dimensions accounting for $> 95\%$ of the shape variance. We also show that these dimensions align with behaviorally relevant states. As an application of this analysis we study the thermal response of worms stimulated by laser heating. Our quantitative description of *C. elegans* movement should prove useful in a wide variety of contexts, from the linking of motor output with neural circuitry to the genetic basis of adaptive behavior.