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Optimal Intermittent Reorientation in Insect Navigation ORIT PELEG, LAKSHMINARAYANAN MAHADEVAN, SEAS, Harvard University, APPLIED MATH LAB TEAM — The process of navigation is often accompanied by several cognitive demanding activities, such as motor control, locomotion planning, and multi-sensory acquisition and integration. Organisms with limited cognitive resources must therefore multitask and develop optimal schemes to dynamically allocate resources to the different tasks. An extreme example of task alternations during navigation is the hallmark of ball rolling dung beetles. The beetles need to roll their dung-ball along a straight path away from the dung pile where intense competition occurs [1]. Before initiating a roll, dung beetles climb on top of the ball and rotate about their vertical axis. This action serves as an orientation mechanism that allows them to set an initial bearing, and to regain this bearing if they experience an unintentional disturbance along the way [2]. We developed a model inspired by the beetle's navigational scheme, where an agent performs a random walk intermittent by reorientation events, in which its heading direction is corrected. We show that the resultant paths are a characteristic of correlated diffusion in short time scale, and biased diffusion in the long time scale [3]. We identify optimal alternation schemes and characterize their robustness upon introducing noisy sensory acquisition and rough environmental conditions.

[1] Warrant, E., & Dacke, M. (2011) *Annual Review of Entomology*, 56(1), 239–254.
[2] Baird, E., Byrne, M. J., Smolka, J., Warrant, E. J., & Dacke, M. (2012) *Plos One*, 7(1), e30211.
[3] Codling, E. A., Plank, M. J., & Benhamou, S. (2008) *Journal of the Royal Society Interface*, 5(25), 813–834.

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