



From Microbiology to Microcontrollers: Effective collective search strategies in T cells and robotic swarms



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ABSTRACT:

In order to trigger an adaptive immune response, T cells move through lymph nodes searching for dendritic cells that carry antigens indicative of infection. We observe that the distribution of step-sizes taken by T cells are heavy-tailed, Levy-like distributions that are characterized by many small steps and rare large steps. Levy walks have been shown to be efficient movement patterns for animals searching for prey. The heavy tailed distribution of step sizes in T cells are a collective property of millions of cells, even though individual T cells do not necessarily move using Levy walks. Our simulations show that T cell movements generate effective collective search strategies that dramatically improve the encounter rate with dendritic cells.

It is not yet known whether the movement we observe is intrinsic to the T cells or is generated adaptively in response to extrinsic factors in the lymph node environment. We implement T cell movement patterns as a search strategy in a swarm of autonomous robots that collectively search for targets in their environment. We compare T cell movement to other collective search strategies and gain insights into how T cell interactions with features of the lymph node might increase encounter rates between T cells and dendritic cells.

Host: Van Savage, Ph.D.

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