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Sensing and Decision-Making in Random Search

Many organisms locate resources in environments in which sensory signals are rare, noisy, and lack directional information. Recent studies of search in such environments model search behavior using random walks (e.g., Lévy walks) that match empirical move- ment distributions. We extend this modeling approach to include searcher responses to noisy sensory data. The results of numerical simulation show that including even a simple response to noisy sensory data can dominate other features of random search, resulting in lower mean search times and decreased risk of long intervals between target encounters. In particular, we show that a lack of signal is not a lack of information. Searchers that receive no signal can quickly abandon target-poor regions. On the other hand, receiving a strong signal leads a searcher to concentrate search effort near targets. These responses cause simulated searchers to exhibit an emergent area-restricted search behavior similar to that observed of many organisms in nature.