ISEF Sample Abstract & Certification

Resource-Explicit Interaction Models for Spatial Populations

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In recent years, population models that utilize continuous spatial frameworks have increasingly found use in lieu of traditional models that consider populations to be well-mixed. This is because the inclusion of spatiality can significantly alter simulation outcomes when modeling many population genetics processes, such as the evolution and spread of beneficial alleles. A fundamental requirement of spatial models is the determination of which individuals can interact with one another, and how strongly they interact. These calculations are used to regulate the population to its local capacity. However, these interactions represent a substantial computational workload, which can lead to prohibitively long runtimes for large populations. Here, we present a novel modeling method in which the resources available to a population are abstractly represented as an additional layer of the simulation. Instead of interacting directly with one another, individuals interact indirectly via this resource layer. We find that this method closely approximates interactions used in other spatial models, yet can increase the speed of the model by as much as an order of magnitude, allowing for the simulation of much larger populations. Additionally, structuring the model in this manner provides other desirable characteristics, including more realistic spatial dynamics near the edge of the simulated area, as well as an efficient route for implementing more complex heterogeneous landscapes and other features.

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