Particle Swarm Optimization (PSO) can be used to efficiently calibrate spatially-explicit agent-based models out of the box.

**What is PSO?**

Particle Swarm Optimization allows particles to explore a space influenced by its current velocity ($v_t$) the best position it has found ($p_t$), and the best position its neighbors have found ($g_t$):

\[
\begin{align*}
v_{t+1} &= k(v_t + c_1 \beta_1 (p_t - v_t) + c_2 \beta_2 (g_t - v_t)) \\
p_{t+1} &= p_t + v_{t+1}
\end{align*}
\]

where $k = \frac{1}{2 - \phi - \sqrt{\phi^2 - 4\phi}}, \quad \phi = c + s, \quad \phi > 4$

\[
v_t = \frac{v_t \cdot \max\{v_t\}}{\|v_t\|}, \quad \text{if } \|v_t\| > \max\{v_t\}
\]

$\beta_1, \beta_2$ are uniform i.i.d. random variables, $c, s$ are cognitive and social constants resp., $p_t, v_t$ are position and velocity at time step $t$.

**INTRODUCTION**

Agent-based models are a powerful tool for simulating and understanding complex spatial phenomena.

Calibrating spatially explicit agent-based models face a variety of challenges:

1. Computationally intensive models
2. Non-convex objective functions
3. Spatial dependencies

We chose to test Particle Swarm Optimization (PSO) on a spatially-explicit ABM for influenza transmission.

**RESULTS**

Our results show that PSO is equally effective at calibrating spatially-explicit agent-based models with fewer evaluations of the model.

Normalized number of cases over a flu season with observed rates (blue dots)

First iteration (top) vs. seventy-second iteration (bottom)

How minimum error achieved is affected by method and hyperparameters of the optimization function

**DATA AND INTERACTIVE VISUALIZATIONS:**