Appendix: Infrastructure construction without information exchange – the trail clearing mechanism in *Atta* leaf-cutter ants

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Automatic traffic flow recording

The below plot shows a comparison of human and automated counts, based on 8 video fragments of 30 seconds length. The automated counts were on average 5.9% lower (mean signed difference; SD = 0.09%). Differences between counts are shown in Figure 1.

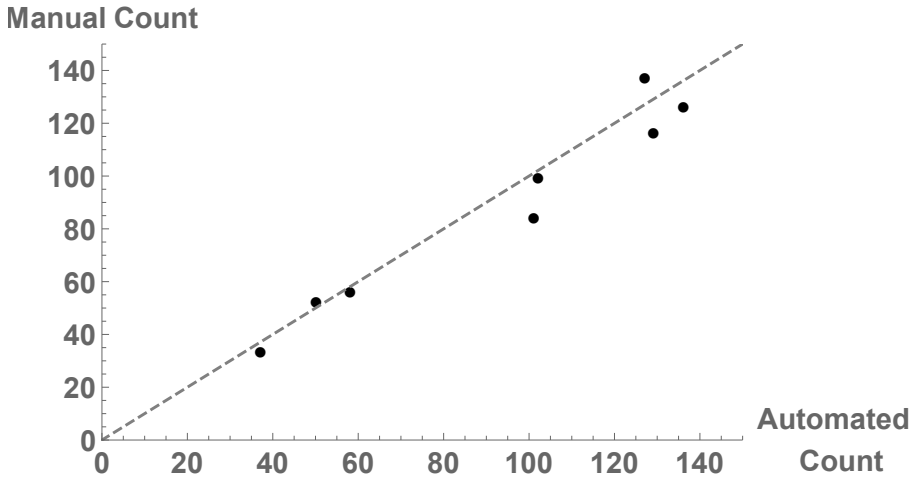

Figure 1: Comparison of human and automated counts. Dashed line indicates matching counts.

Gillespie Algorithm details

In the implementation of the Gillespie algorithm we largely used method and notation given by (Twomey; 2007).

Given an initial amount of reagents (i.e., workers and obstructions) and reaction rates, the algorithm at the beginning of the experiment and at each removal event calculated the propensities of occurrence α_i ($i \in \mathbb{Z} : 1 \leq i \leq 4$) for each possible removal reaction w_i ($i \in \mathbb{Z} : 1 \leq i \leq 4$) based on the involved reagents (see Table 4

in the manuscript body) and the encounter modifier function $m(O)$. It then generated the next reaction time tau and reaction type w_μ ($\mu \in \mathbb{Z} : 1 \leq \mu \leq 4$) via two random numbers r_1 and r_2. Pseudocode for the algorithm is given in Algorithm 1. A Mathematica notebook with the corresponding code is provided as electronic supplementary material.

$t = 0$;
Initialise reagent counts;
while *simulation running* **do**
  $\alpha_0 = \sum_{i=1}^{4} \alpha_i$;
  $r_{1,2} \sim U[(0,1)]$;
  $\tau = \frac{1}{\alpha_0} \ln\left[\frac{1}{r_1}\right]$;
  $\mu = \min m\{m \in \mathbb{Z} : 1 \leq m \leq 4\} : \frac{1}{\alpha_0} \sum_{i=1}^{m} \alpha_i > r_2$;
  $t = t + \tau$;
  execute reaction w_μ;
end

Algorithm 1: Gillespie algorithm. See above text for details.

References

Twomey, A. (2007). *On the stochastic modelling of reaction-diffusion processes*, PhD thesis, University of Oxford.