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Mitigating clogging and arrest in confined self-propelled systems WILLIAM SAVOIE, JEFFREY AGUILAR, DARIA MONAENKOVA, VADIM LINEVICH, DANIEL GOLDMAN, Georgia Institute of Technology — Ensembles of self-propelling elements, like colloidal surfers, bacterial biofilms, and robot swarms can spontaneously form density heterogeneities. To understand how to prevent potentially catastrophic clogs in task-oriented active matter systems (like soil excavating robots), we present a robophysical study of excavation of granular media in a confined environment. We probe the efficacy of two social strategies observed in our studies of fire ants (S. invicta). The first behavior (denoted as unequal workload) prescribes to each excavator a different probability to enter the digging area. The second behavior (denoted as reversal), is characterized by a probability to forfeit excavation when progress is sufficiently obstructed. For equal workload distribution and no reversal behavior, clogs at the digging site prevent excavation for sufficient numbers of robots. Measurements of aggregation relaxation times reveal how the strategies mitigate clogs. The unequal workload behavior reduces the tunnel density, decreasing the probability of clog formation. Reversal behavior, while allowing clogs to form, reduces aggregation relaxation time. We posit that application of social behaviors can be useful for swarm robot systems where global control and organization may not be possible.

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