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Collective workload organization in confined excavation of granular media[1] DARIA MONAENKOVA, VADIM LINEVICH, MICHAEL A. GOODISMAN, DANIEL I. GOLDMAN, Georgia Institute of Technology — Many social insects collectively construct large nests in complex substrates; such structures are often composed of narrow tunnels. The benefits of collective construction, including reduced construction costs per worker come with challenges of navigation in crowded, confined spaces. Here we study the workforce organization of groups of *S. invicta* fire ants creating tunnels in wet granular media. We monitor the activity levels of marked (painted) workers–defined as a number of tunnel visits over 12 hours– during initiation of tunnels. The activity levels are described by a Lorenz curve with a Gini coefficient of ~ 0.7 indicating that a majority of the excavation is performed by a minority of workers. We hypothesize that this workload distribution is beneficial for excavation in crowded conditions, and use a 2D cellular automata (CA) model to reproduce behaviors of the excavating ants. CA simulations reveal that tunnel construction rates decrease in groups of equally active animals compared to groups with the natural workload distribution. We use predictions of the CA model to organize collective excavation of granular material by teams of digging robots, and use the robots to test hypotheses of crowded excavation in the physical world.

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