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Environmental engineering simplifies subterranean locomotion control NICK GRAVISH, DARYA MONAENKOVA, MICHAEL A.D. GOODISMAN, DANIEL I. GOLDMAN, Georgia Institute of Technology — We hypothesize that ants engineer habitats which reduce locomotion control requirements. We studied tunnel construction, and locomotion, in fire ants (*Solenopsis invicta*, body length $L = 0.35 \pm 0.05$). In their daily life, ants forage for food above ground and return resources to the nest. This steady-state tunnel traffic enables high-throughput biomechanics studies of tunnel climbing. In a laboratory experiment we challenged fire ants to climb through 8 cm long glass tunnels (D = 0.1 - 0.9 cm) that separated a nest from an open arena with food and water. During ascending and descending climbs we induced falls by a motion-activated rapid, short, downward translation of the tunnels. Normalized tunnel diameter (D/L) determined the ability of ants to rapidly recover from perturbations. Fall arrest probability was unity for small D/L, and zero for large D/L. The transition from successful to unsuccessful arrest occurred at $D/L = 1.4 \pm 0.3$. Through X-Ray computed tomography study we show that the diameter of ant-excavated tunnels is independent of soil-moisture content (studied from 1-20%) and particle size (50-595 μm diameter), and has a mean value of $D/L = 1.06 \pm 0.23$. Thus fire ants construct tunnels of diameter near the onset of fall instability.

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