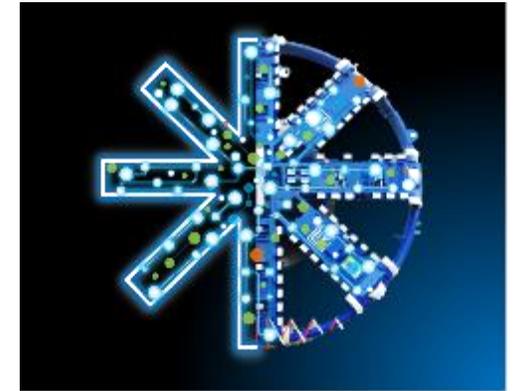


Mike Mooney, PE PhD

Grewcock Chair Professor, Center for Underground Director

mmooney@mines.edu; +1 (303) 881 7200

- Expertise: rapid tunnel construction technology including directional drilling; ground-machine interaction; soil/rock behavior; sensing while tunneling/drilling; data-driven and physics-based modeling of excavation processes; near surface geophysics and ground characterization; prototype development, implementation and field demonstration.
- Why I am here: listen and learn, contribute, calibrate.
- Expectations: (1) understanding of solicitation direction; (2) skillsets/capabilities of participants; (3) leads on partnership options.



Experience/Achievements Related to ARPA-E Undergrounding

- ▶ Developed ultra-rapid (compared to current practice) small diameter (8-10 in) near-surface tunnel construction technology as a lead contractor in DARPA Underminer program. Demonstrated 1200 ft/hr installation rate over 1700 ft distance. Max advance rate demonstrated = 3000 ft/hr.
- ▶ Advanced numerous innovations: single pass lining installation while excavating for distances up to 3 miles; continuous tunneling; hydraulic-mechanical hybrid excavation; low annulus fluid pressure while rapidly excavating to mitigate frac-out risk; directional drilling and control; sensing downhole with wireline telemetry; small footprint equipment design for urban environments.
- ▶ Assembled high performing university-industry team involving multiple disciplines: civil, mechanical, geotechnical, electrical, chemical, computer science, petroleum.

Experience/Areas of Expertise Related to ARPA-E Undergrounding

- ▶ AI of tunnel construction for optimization, risk mitigation, autonomous operations.
- ▶ Sensing during construction.
- ▶ Utility network design experience for urban environments.
- ▶ Urban subsurface sensing and characterization using active and passive acoustics/seismic, electrical/EM, gravity and magnetics approaches.
- ▶ Sensing during construction; sensing at bit; imaging ahead; feedback control tunneling.
- ▶ Alternative tunnel lining construction techniques.
- ▶ Autonomous shaft construction.
- ▶ Techniques to minimize cuttings removal while drilling; and to minimize drilling fluid consumables.
- ▶ Spatial uncertainty characterization and Bayesian updating; resultant risk-based decision making.
- ▶ Digital twinning and remote operations via digital gaming environment.