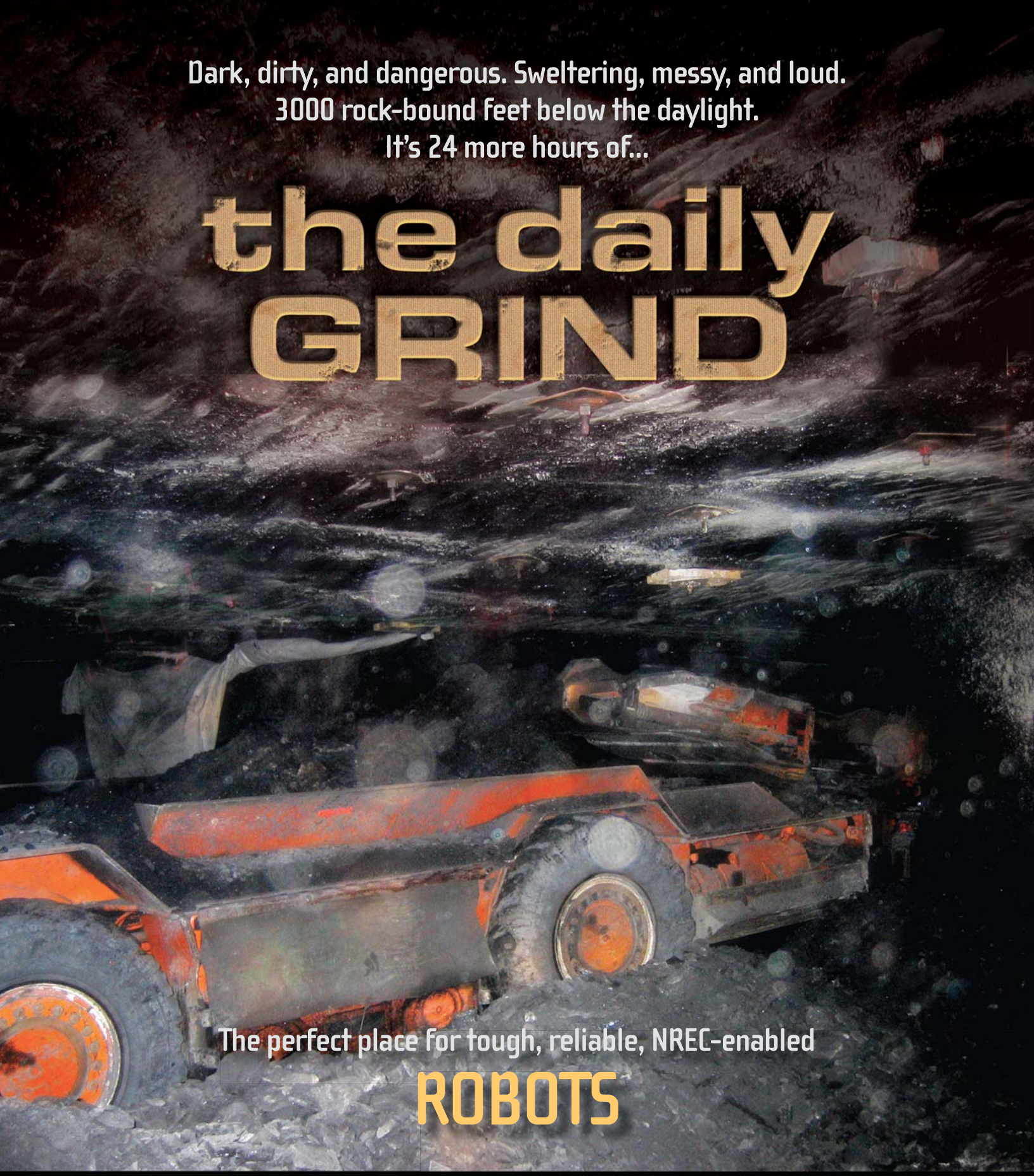
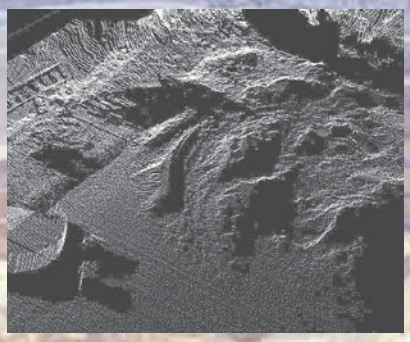


ENGINEERING THE FUTURE OF ROBOTICS

NATIONAL ROBOTICS
NREC
ENGINEERING CENTER

NREC transforms mining operations with rugged, reliable robotics technologies

- Automated mining equipment
- Operator assistance / Remote operation
- Sensor systems designed to see through dust
- Vision-based inspection systems
- Autonomous mine mapping robots
- Autonomous exploration robots



LADAR vision systems analyze underground contours and obstacles

Sensors see through mine dust to analyze and direct operations

Belt Inspection system reveals flaws before expensive breakdowns

The Explorer robot travels untethered through pipe networks to inspect for problems

Mining equipment outfitted with cameras, sensors, and other NREC-enabled technology

Increase Productivity

- Autonomy and operator-assistance technologies optimize mining processes and mining equipment operation.
- Drills, miners and shearers are guided with laser precision for maximum extraction from the ore body.

Improve Safety

- Operators can use autonomy and operator assistance to supervise mining equipment from a safe shelter, away from machines and hazardous areas.
- Consistent and never-tired robotics technologies can reduce human errors.

Reduce Operating Costs

- Vision systems continuously monitor operations such as fragmentation, which lowers waste and reduces costs.
- Obstacle detection and avoidance systems help keep vehicles and machines from driving over debris that could cause tire or equipment damage.
- Autonomy and operator assistance allow equipment to operate properly within manufacturer specifications.
- Vision-based inspection systems detect failures in mining equipment (such as conveyor belts) before they occur.

Real World Applications

Conveyor Belt Inspection for Failure Prevention

NREC conveyor belt inspection systems detect mechanical and vulcanized splice failures before they occur. Deteriorating splices can be fixed during scheduled belt downtime, saving hundreds of thousands of dollars in lost productivity. This system is currently in use at more than 15 underground mines.

Underground Mining Operator Assistance

This NREC-developed system measures the sump depth of a continuous mining machine without the use of external infrastructure. It also provides global heading information using a laser reference. This improves mining productivity and decreases health and safety hazards to mining workers.

Pipeline Explorer

The first untethered robot for inspecting pipelines, Pipeline Explorer is currently used to inspect natural gas mains for cracks & other failures. An operator controls Explorer through a wireless data link and can monitor pipeline images in real time.

Carnegie Mellon

NATIONAL ROBOTICS NREC ENGINEERING CENTER

ENGINEERING THE FUTURE OF ROBOTICS

Please contact: **Jeff Legault**
National Robotics Engineering Center
Ten 40th Street • Pittsburgh, Pennsylvania 15201
412.681.6900 • Fax 412.681.6961 • www.NREC.RI.CMU.edu