TARDEC

Tank-Automotive Research, Development and Engineering Center

Surrogate Instrumented Mine:

An Engineering Tool to Optimize, Verify, and Characterize Counter Mine Equipment

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14. ABSTRACT
The most common threat mines are pressure fused. In order to neutrazlize these mines, the army has developed many systems incluyding: plows, flails, line charges, rollers, and various other innovations. These systems rely on placing large amounts of pressure in front of a vechile to detonate the mine before the mine is under the vehicle. The pressure needed to detonate these AT or AP mines is variable to soil type, buried depth, age and mine type among other variables.

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Surrogate Instrumented Mine

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Need for Countermine Equipment Testing

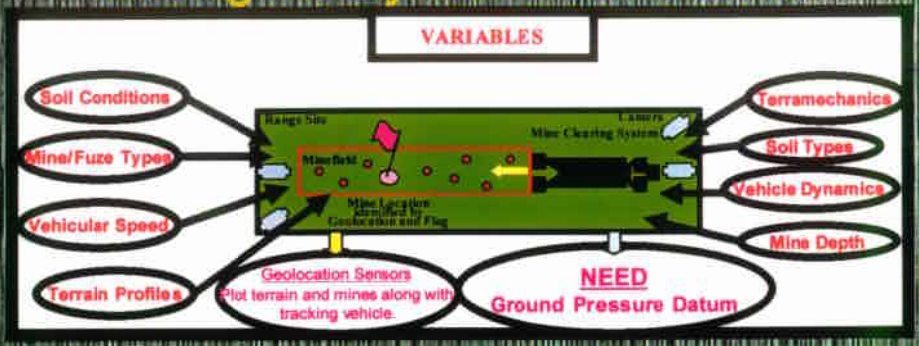
The most common threat mines are pressure fused. In order to neutralize these mines, the army has developed many systems including: plows, flails, line charges, rollers, and various other innovations. These systems rely on placing large amounts of pressure in front of a vehicle to detonate the mine before the mine is under the vehicle. The pressure needed to detonate these AT or AP mines is variable to soil type, buried depth, age, and mine type among other variables.

Current Countermine Equipment Testing

Current Testing of Countermine Equipment is conducted on a test lane seeded with 25 M-20 Training mines fused with a M-604 smoke trigger. Problems with this include:

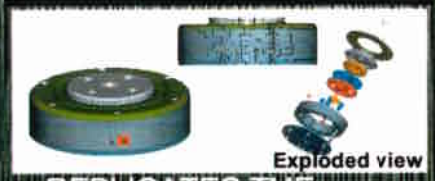
- Mines are single use.
- Mines were manufactured in the 1950's.
- Mines give go/no-go data.
- Mines require EOD infrastructure and personnel.

Intelligent Dynamic Mine Lane

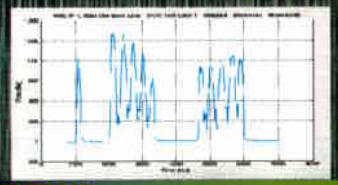


This effort will develop a test lane to measure dynamic ground pressure based on vehicle dynamics, soil conditions, and mine placement. This will be done using geolocation sensors, cameras, soil analysis equipment, Surrogate Instrumented Mines (SIM), and Subsurface Ground Pressure Sensors (SGPS).

SURROGATE INSTRUMENTED MINE

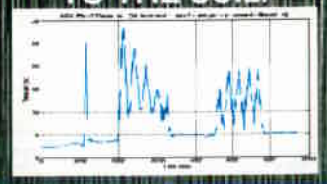


REPLICATES THE MECHNICAL FUSING AND PHYSICAL ATTRIBUTES OF AN M-15/M-20 MINE.



SUBSURFACE GROUND PRESSURE SENSOR

MEASURES SUBTLE VARIATIONS IN GROUND PRESSURE WITH LITTLE DISTURBANCE TO THE SOIL.



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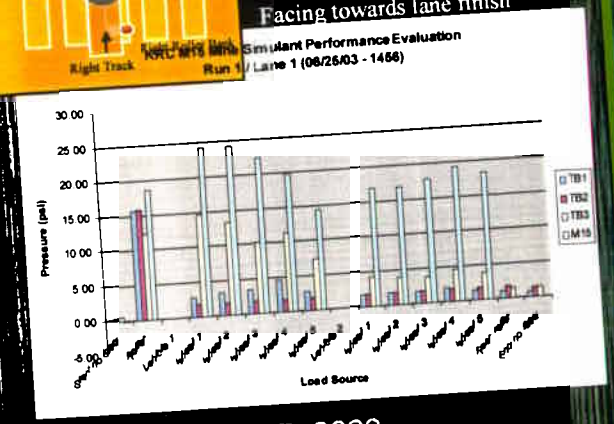
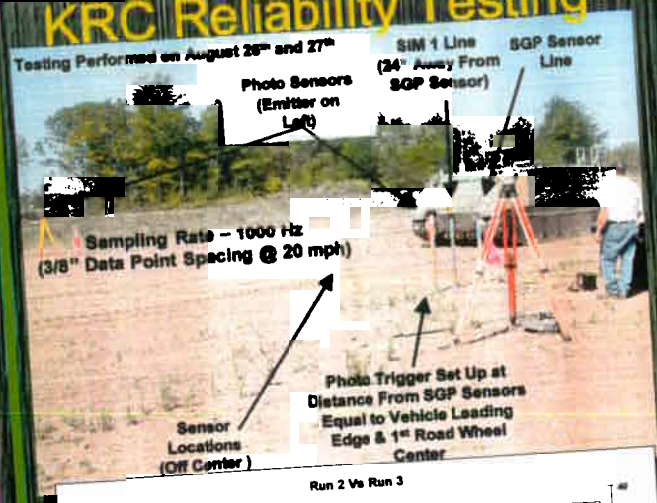
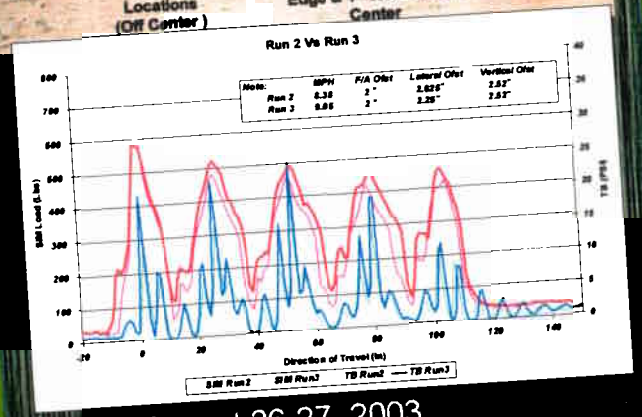
ATC Initial Testing



When: June 23-27, 2003
Target: Panther Light UGV
Purpose: Confirm the operation and sensitivity of the sensors and to augment the traditional test lane.
Conclusions: The data demonstrates sufficient pressure sensitivity to detect even near miss loads by the sensors. This proved the SIM is a tool that will provide us with unprecedented insight into roller performance and vehicle load distribution.

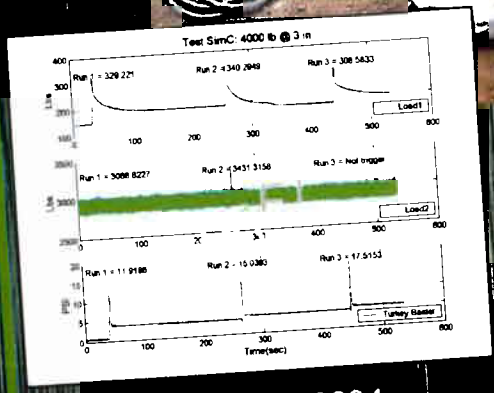
KRC Reliability Testing





When: August 26-27, 2003
Target: M113 Tracked APC
Purpose: Verify the repeatability of the sensors by running over 40 test runs while varying the speed, depth of burial, and encounter location.
Conclusions: The data demonstrated that runs very similar in test conditions were measured very similar by the sensors.

NSDL Validation Testing



When: March 8-11, 2004
Target: Controlled wheel carriage system
Purpose: Verify sensors are recording accurate load data by comparing its readings to that of NSDL's 6-sensor stress-state transducer while varying the depth of burial and loading of the wheel.
Conclusions: Data from this test is currently being analyzed.

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Scheduled Usage

JOINT AREA CLEARANCE ACTD MILITARY UTILITY ASSESSMENT

The JAC ACTD MUA will use the SIMs and SGPS to help evaluate the many submitted demining vehicles with the goal of providing the Army and USMC with a scoring system applied to this equipment. This system will help determine which systems are ready for the field, which need more development, and which should be left behind. This testing will be conducted May 3-7, 2004 at Camp Lejeune, NC and supported by the 27th Combat Engineer Platoon.

LIGHTWEIGHT MECHANICAL COUNTERMINE EQUIPMENT STO

This STO will produce a cost effective on and off route lightweight mechanical system to neutralize, clear, and proof impediments to battlefield mobility that cannot be bypassed. The Sensors will measure STO products to quantify the level of improvements in each engineering cycle. The data analysis from these tests provides a more cost effective solution versus the build and try-until fail techniques previously employed.

Future Enhancements

The primary focus of near term enhancements will be in retrofitting with a embedded commercial off-the-shelf wireless data acquisition system with specifications

(a) Sampling rate (200 kHz with 16 bit resolution)
(b) Robustness (no degradation in performance after a minimum of 20 passes with a tracked 70T vehicle)
(c) Memory (record 20 minute period of data internally)
(d) Wireless Transmission (10 meters buried)
(e) Wired Transmission (previous functionality)
(f) Unit cost

Future Enhancements will allow the SIM to replicate other mine types beyond the M20, such as M14, TM 46, and Type 72 among others

Future Applications

AT Overpass: The GSTAMIDS ORD requires the Mine Detection Vehicle to have a set pressure exerted on the ground in order not to exceed the pressure required to detonate an AT Mine.

Threat Analysis: The SIM could be used to help in predicting which mine types would be detonated by future and current force vehicles.

Countermine Equipment: The SIM could be adjusted to be used against other countermine equipment such as plows, sympathetic detonation, and flails.

Mine Research: The SIM could be used to create/validate equations and theories about the reaction of soil to a mine in order to equate a surface load and area to a pressure plate load.

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THE PANTHER LIGHT UGV FOR OEF/OIF

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Mechanical Wire Cutting Kit
PROVIDES A COUNTERMEASURE FOR MANY IED TYPES

Tele-Operation Control Kit
PROVIDES STANDOFF OPERATION TO 1000 M

DVE FLIR Kit
PROVIDES 360 DEGREE NIGHT VISION TO 500 M

L M R
PROVIDES TRACK WIDTH VEHICLE PROTECTION WHILE NEUTRALIZING MINES/IED/UXO

T V Linkage Kit
ENABLES MOBILITY, TRACTIVE EFFORT

R M R
PROVIDES FULL WIDTH NEUTRALIZATION OF MINES/IED/UXO

Panther Light UGV:
CURRENT FORCE BASELINE CAPABILITY FOR STANDOFF ASSAULT BREACHER (SABRE)

LOW COST S S C S R A C M
Neutralization of Command Detonated, Pressure, Magnetic, Seismic, Tilt Rod and Trip Wire Fused MINE/IED/UXO

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