



Real-Time Temperature Profiling in Underground Mines

A proof of Concept Using Distributed
Temperature Sensing Based on Optical Fibre

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Heat Safety: A Non-Negotiable for Zero Harm



Zero Harm Culture

Prioritising worker health and safety in every

Heat Exposure Directly Increases Accident Risk



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Heat Safety: A Non-Negotiable for Zero Harm



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**THE EMPLOYER AT A MINE
GAUTENG REGION**

Dear Sir/Madam,

**INSTRUCTIONS ON PREVENTION OF OCCUPATIONAL HYGIENE OVER
EXPOSURES**

OFFICIAL

DMPR INSTRUCTION

CIOM-INSTR. OH-01-2024

3. Instruction(s)

The following instructions are issued as an additional measure to prevent occupational health exposures in the South African Mining Industry thereby ensuring the health and safety of persons at mines. The employer must ensure that at least the following key areas are addressed:

3.1 Implement Real-time monitoring

Source: CIOM-INSTR. OH-01-2024

Challenges of current methods

Point Sensors

- Fixed
- Blind spots
- Complex installation
- Needs comms, maintenance
- Multiple power connections



Thermal Imaging

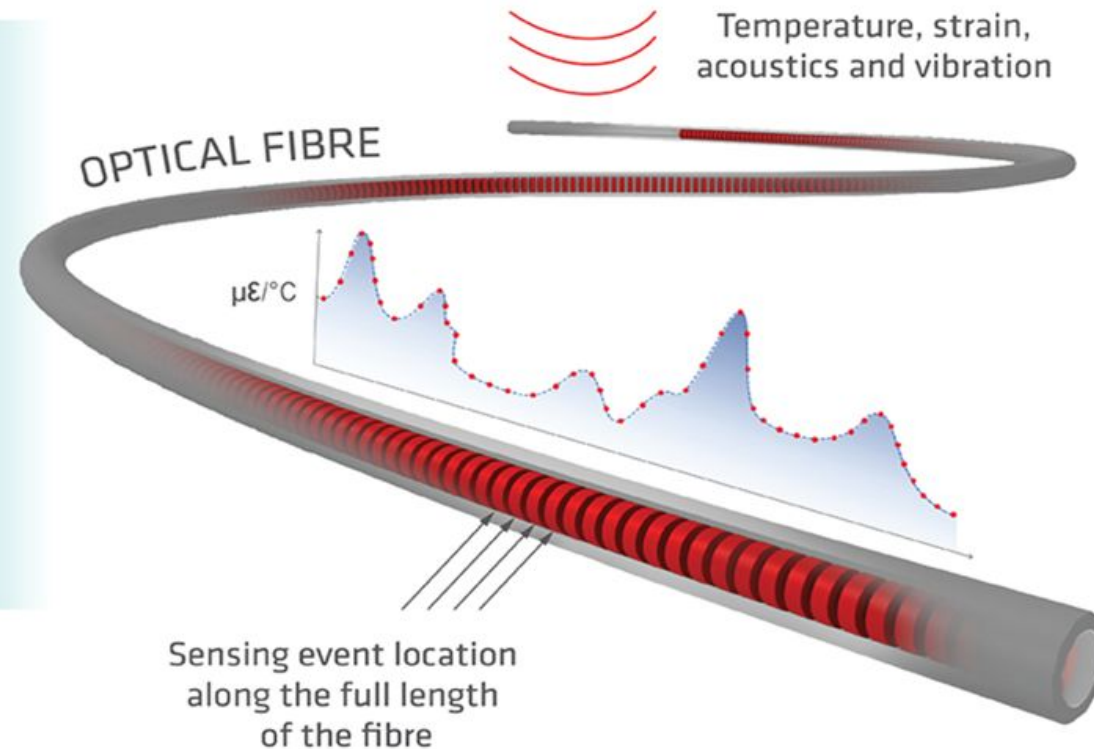
- Flexible
- Manual operation
- Blind spots

What is Distributed Fibre Optic Sensing?

DISTRIBUTED FIBRE OPTIC SENSING

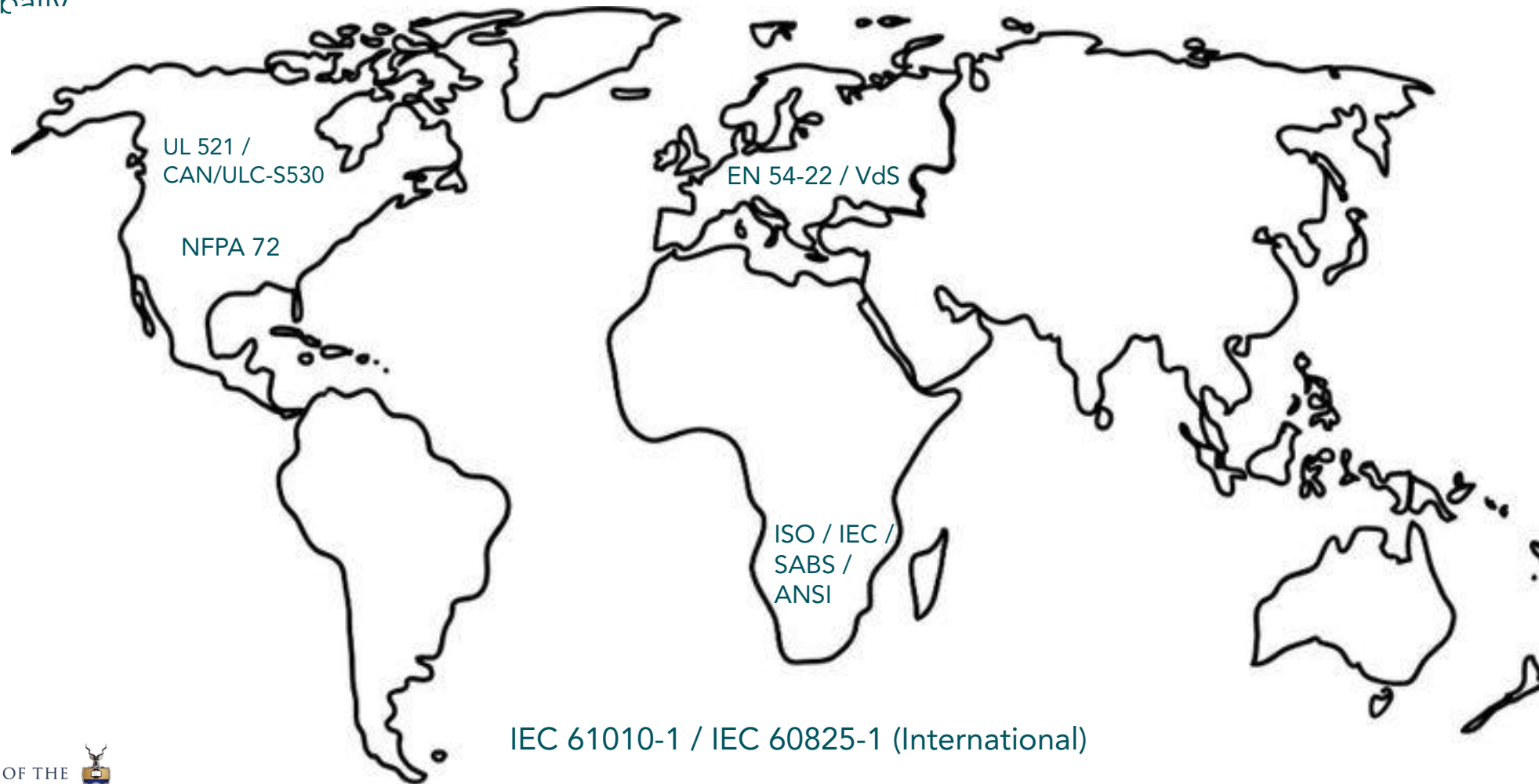
Imagine a digital nerve in your mining operation that can be extended as requirements expand, giving you real-time critical data to reduce safety and environmental risks, increasing equipment reliability and production.

THE FIBRE IS THE SENSOR



DTS Jurisdictional Compliance & Standards

Key safety and fire-detection standards governing Distributed Temperature Sensing systems in South Africa and globally



Validation Framework

Ensuring research
credibility.

1

Literature Review

2

Feasibility

3

POC Deployments

Literature Review

Research Aim

Test DTS applicability and accuracy for real-time temperature monitoring.

Validate Accuracy ($\pm 1^{\circ}$

C)

1

2

Objectives

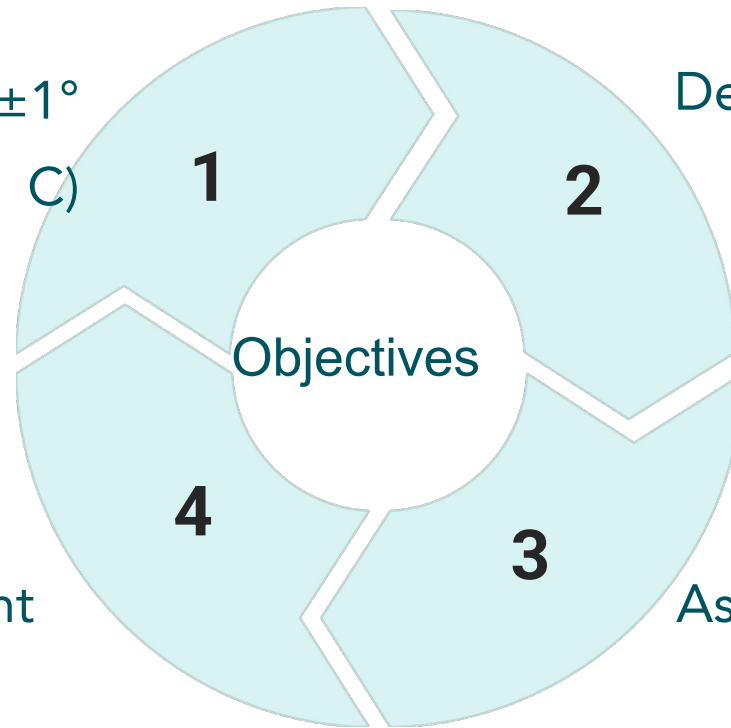
4

3

Explore Deployment

Detect Heat Sources

Assess Responsiveness



Literature Review

 Fibre Bragg Grating

 Thermal Imaging

 Whirling
Hygrometer
 Distributed Temperature
Sensing

 Point Sensors

Evaluation Method

Literature-backed scoring across three critical dimensions



Key Criteria

- Reliability
- Survivability
- Availability

Clear Winner

Distributed Temperature Sensing (DTS) outperformed thermal imaging and point sensors by a significant margin across all evaluated criteria.

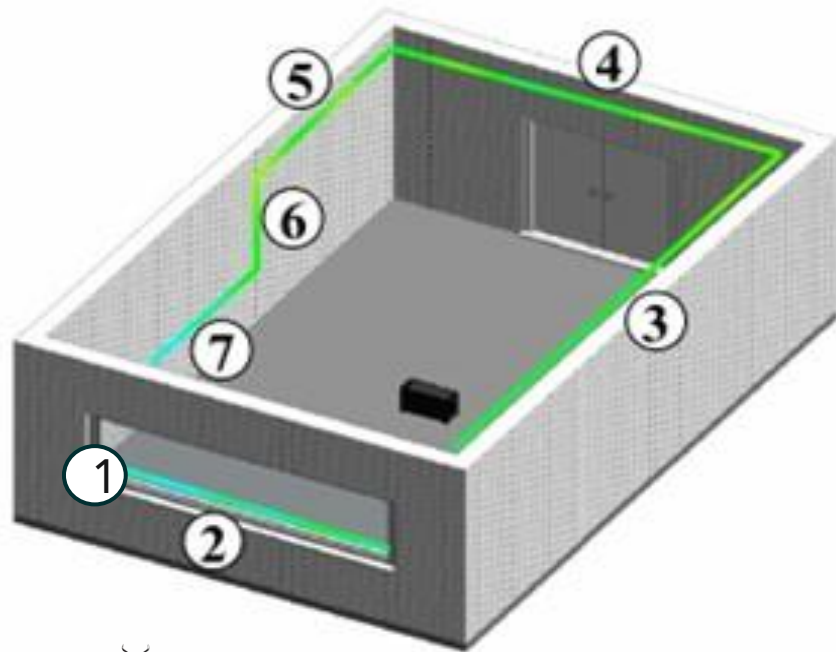
Feasibility

Quantitative Lab Test

Controlled Testing

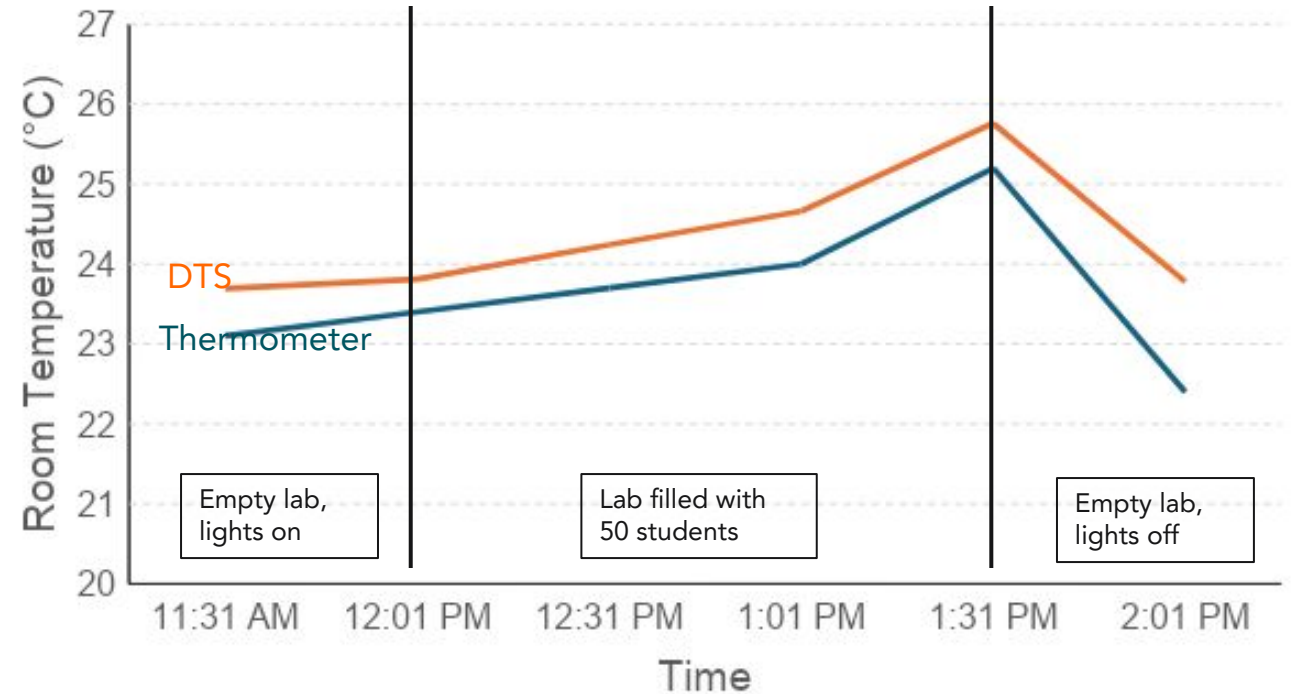
Environment

- Computer lab (14m × 7m × 3m)
- 60 m armored fibre across 7 zones



Dynamic Response &

Accuracy between DTS & Traditional Thermometer



Feasibility

Proof of

concept

This study demonstrates that DTS delivers

validated in

lab



**Wider Spatial
Coverage**



**Real-Time
Visualization**



**Enhanced Early
Warning**



Accurate (Dry bulb)

Underground POC's Started

Joel Mine in progress, South Deep Mine

pending



Validation

- Validate lab results
- Compare with other systems
- Confirm reliability, practicality and accuracy



Critical Area

Deployment

- Intake x/cut
- Centre gulleys
- Stopes
- Return airways



System

Integrate DTS with existing communication systems

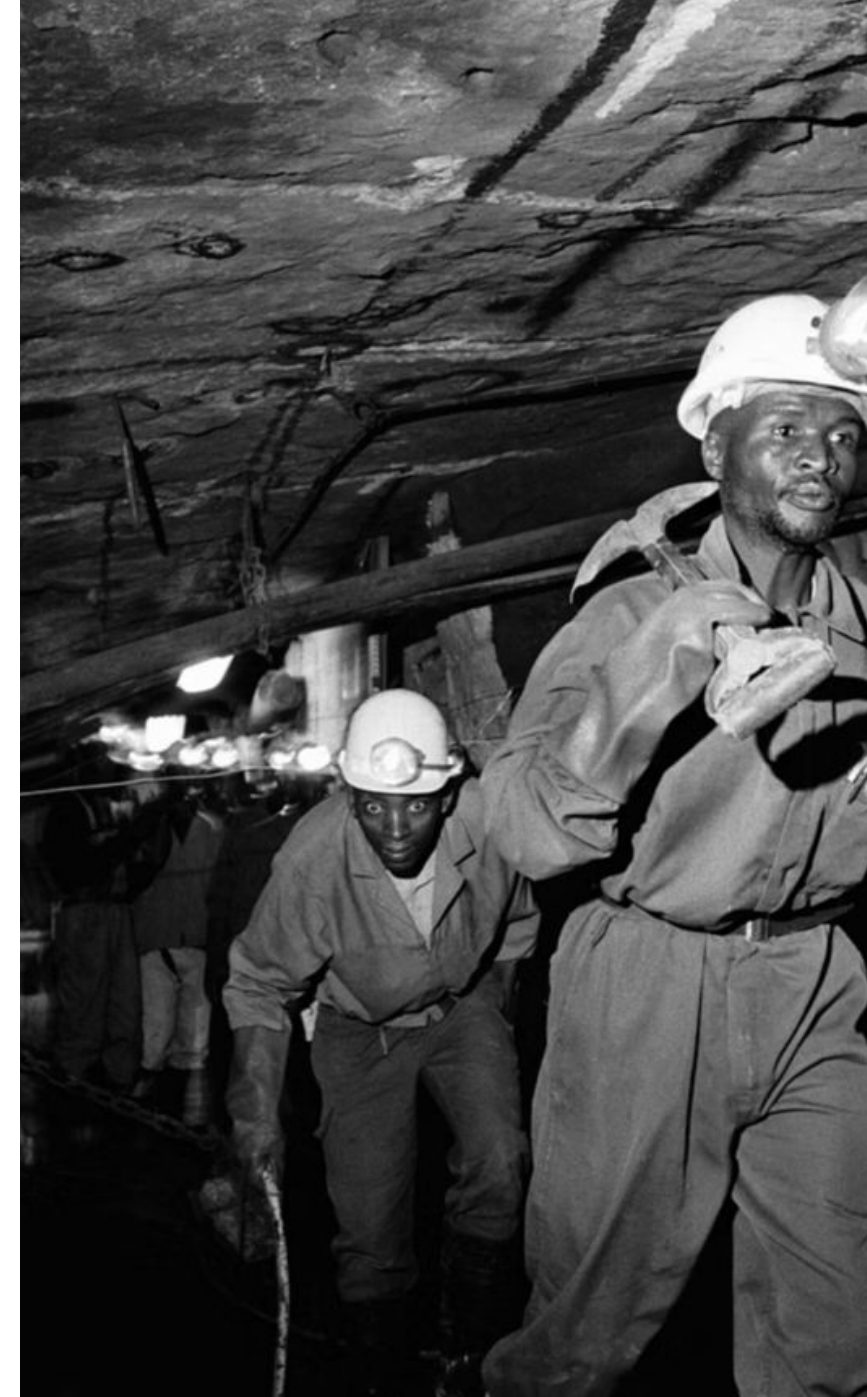
Integration



Automated Control

Regimes

Move toward safer, automated control systems that respond to real-time temperature data



Commitment to ZERO Harm



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