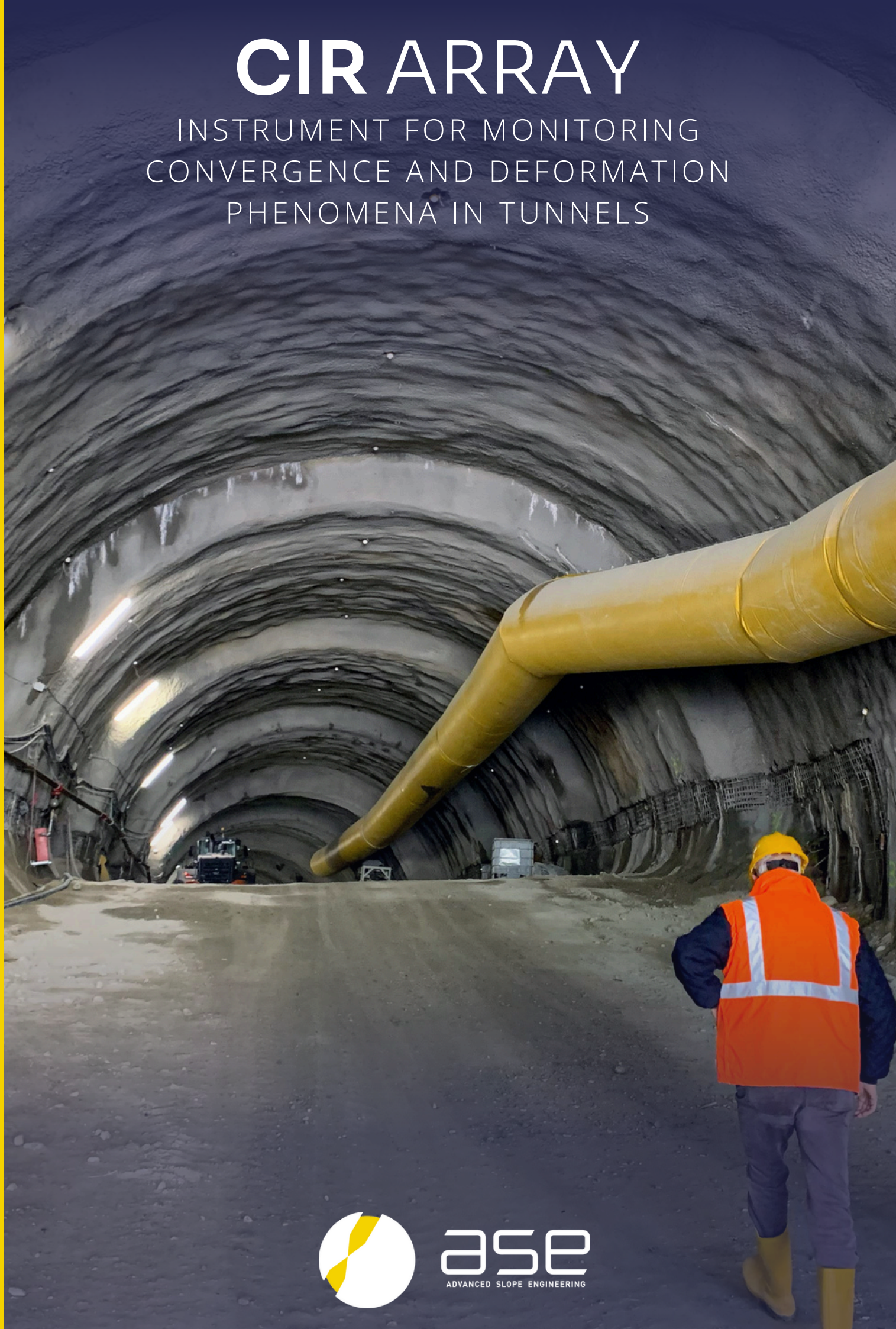
WE MONITOR THE PRESENT WITH THE INSTRUMENTS OF THE FUTURE

CIR ARRAY

INSTRUMENT FOR MONITORING CONVERGENCE AND DEFORMATION PHENOMENA IN TUNNELS



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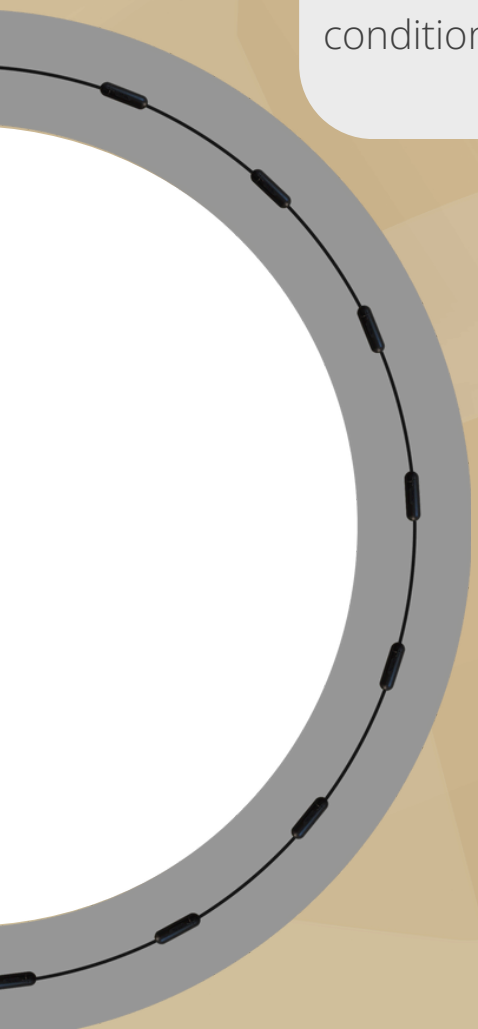
ADVANCED SLOPE ENGINEERING

CIR **ARRAY**

Cir Array is an instrument designed for monitoring **3D convergence** and **localized deformation phenomena** in tunnels, whether under construction or existing. It consists of a sequence of IP69 hermetic nodes connected by a fiberglass rod, which is necessary to maintain alignment, and a cable for data transmission. Each node contains a high-resolution **3D MEMS sensor** and a **thermometer**.

Based on project requirements, it is possible to customize the number of sensors, their spacing, and the overall length of the instrument. The Cir Array allows for the collection of detailed data along the entire monitored tunnel section, providing a comprehensive and accurate overview of the structural conditions.



Accurately detect **3D convergence** and **deformations**, ensuring structural integrity at every stage of construction or operation.

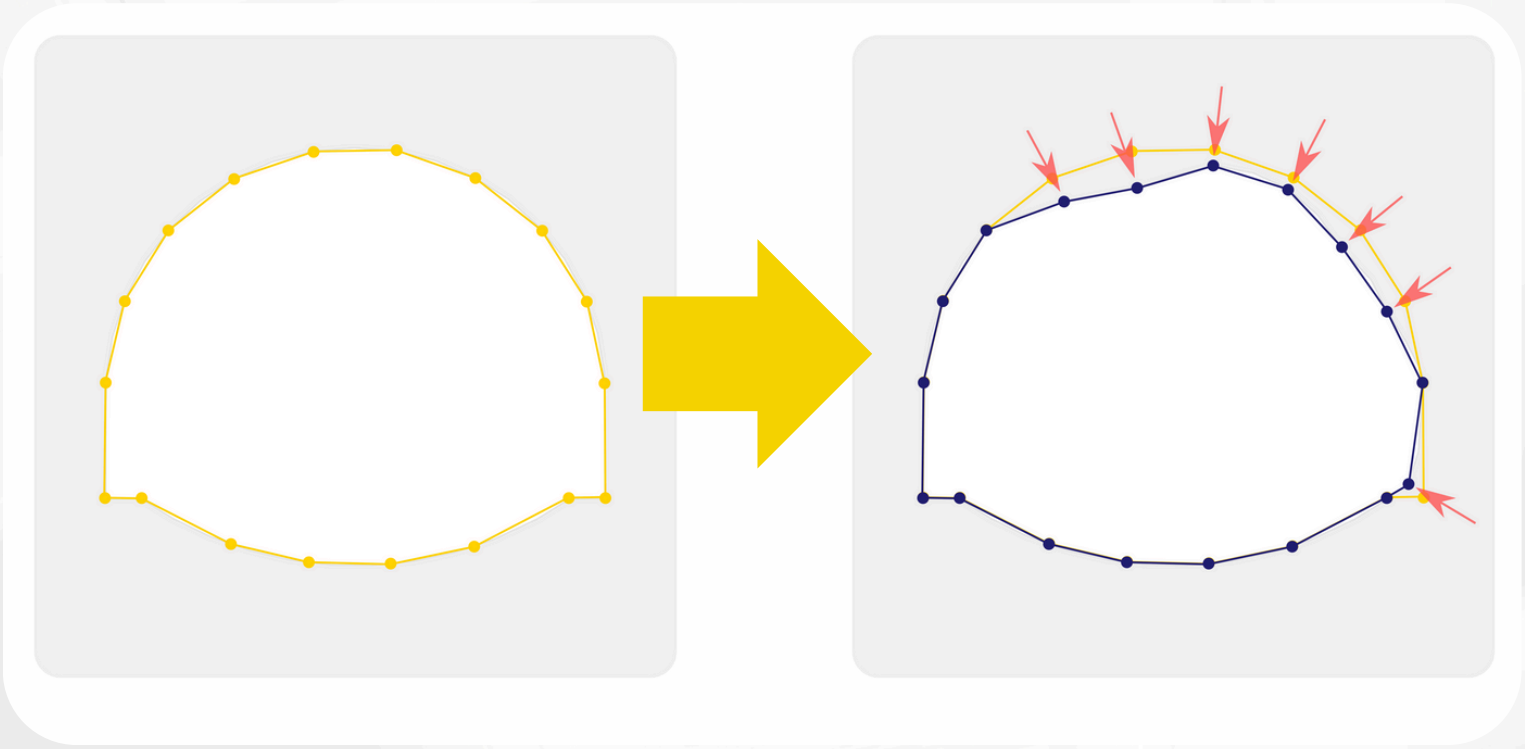
Tunnel Link
3D MEMS
Thermometer

INSTALLATION

The instrument **can be installed** in a section of a **tunnel under construction** near the excavation face, **in contact with the rock mass** or **on the preliminary lining**, to monitor deformations resulting from the excavation. Alternatively, it can be placed **on the final lining** to monitor the structure during the **operational phase**. The **installation** is **quick** and **easy**. The instrument is supplied in segments that are then joined together using special connectors. Once the section to be monitored is identified, the instrument can be secured to the structure using appropriate clamps.

WORKING PRINCIPLES

By knowing the distance between the nodes and their orientation, determined using data recorded by the MEMS sensor, it is possible to identify the relative position of the instrument in space through specific algorithms and, consequently, the deformations of the structure.



DATA FROM SENSORS

STORAGE

ANALYSIS

DATA REPRESENTATION

INSTRUMENT RESULTS

- Cumulative displacements
- Local displacements
- Time evolution of local displacements (X-Z)
- Time evolution of cumulative displacements (X-Z)
- Time evolution of displacement rate/acceleration
- Time evolution of convergence segments
- Length of convergence segments (first/last reading)
- Temperature of each individual node
- Radial local displacement along the chain
- 3D graph
- Time evolution of the tunnel's cross-sectional area
- Temperature and Battery Level

DATASHEET

Sensors	3D Accelerometer, Thermometer
Measurement range	360°
Accelerometer range	± 1.2 g
Accelerometer sensitivity	105 LSB/° (0.0095°) 6000 LSB/g (0.167 mg) 0.166 mm/m
Accelerometer sensitivity error	±0.7%
Accelerometer sensitivity dependence on temperature	±0.3%
Accelerometer linearity error	±4 mg
Offset error evaluating absolute positions	±1.15° ±20 mg
Offset dependance on temperature	±0.57° for X & Y axes, ±0.86° for Z axis ±10 mg for X & Y axes, ±15 mg for Z axis
Drift of the offset error	±0.23° for X & Z axes, ±0.34° for Y axis ±4 mg for X & Z axes, ±6 mg for Y axis
Accelerometer amplitude response	40 Hz
Accelerometer temperature operating range	-40 °C ÷ +125 °C
Thermometer measuring range	-50 °C ÷ +150 °C
Thermometer sensitivity	18.9 LSB/°C (0.053°C)
Total accuracy	Depending on MUMS chain configuration and length
Node length and diameter	125 mm – 37 mm
Node weight	0.2 kg
Electrical cable	CEI 20-35

OUR MISSION

Develop and disseminate new technologies for monitoring natural phenomena and structures in order to deepen the knowledge of their dynamics, strengthen the theoretical basis for theoretical interpretation and make safer, cheaper and more functional design activities of civil and environmental works as well as Civil Protection procedures.

ABOUT US

ASE is an SME based in Parma, founded in 2013 and sponsored by the University of Parma. Our company, born as a Start-Up, has established itself over time as a leader in the development of innovative tools for geotechnical and structural monitoring, as well as in the creation of state-of-the-art software and hardware for managing monitoring data from automatic systems, topographic surveys, and manual instruments.
What sets us apart is the multidisciplinarity of skills within the company. Within ASE, a team composed of Civil, Environmental, and Electronic Engineers, along with highly qualified expert programmers, collaborates to internally develop both the instruments and software solutions, allowing us to maintain a high level of control over the quality and efficiency of our products.
The core of the company is driven by a profound passion for research and development. We recognize the importance of staying at the forefront of the latest technological and scientific innovations to provide our customers with solutions tailored to their needs.
In summary, ASE is much more than just a company: it is a center of excellence, a reference point for monitoring, and a reliable partner in ensuring the safety and reliability of infrastructures worldwide.

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CONTACT US
TO RECEIVE MORE INFORMATION

www.aseltd.eu

info@aseltd.eu / sales@aseltd.eu

+39 0521 1404292

Via R.Koch 53/A, 43123 Fraz. Pilastrello, Parma - Italy
VAT IT02687890349

ase
ADVANCED SLOPE ENGINEERING