Call for application for research scholarships

for post-graduate international candidates

RESEARCH PROJECT N. 18

Title

Innovative monitoring methods in tunnelling (TunnelSense)

Scientific responsible (name, surname, role)

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Short description of the research activity (max 250 words)

Tunnelling is used worldwide for new infrastructures. Monitoring of such parameters as temperature, stress, strain and vibration is a fundamental aspect of tunnel construction. However, advancement in monitoring methods occurred in other fields have not fully entered the tunnelling market for a number of technical and economical reasons.
The research is devoted to investigate advanced and innovative monitoring techniques to be adopted in different stages of tunnel construction, control and maintenance, to overcome the economical and technical barriers and enhance their adoption in the field. Two techniques will be considered: fiber optics and ground based radar interferometry.

FIBER OPTICS
Fiber optics can be embedded in the concrete lining of the tunnel to monitor quantities during construction and service life. However, implementation techniques need to be improved to allow for practical and economical use. Moreover, the possibility of monitoring by remote may be particularly attractive for maintenance and performance control of the tunnel, which could be conducted with the same construction monitoring tools, i.e. with relevant cost savings. The research will include laboratory and field experiments:

- Laboratory tests can be conducted at DISEG. Measures from fibre optics embedded in concrete elements will be compared to other systems during loading cycles to optimise implementation procedures. Innovative distributed sensing solutions will also be studied in collaboration with PhotoNext, a newly funded initiative at POLITO on innovative applications of photonic technologies.
- Data from an existing experimental site recently completed in the Turin ML1 tunnel will be used. Here, one ring of segmental lining is equipped with fibre optics embedded during precast to monitor stresses, strains and temperatures. Comparison with vibrating-wire and load cells data is available. The possibility to conduct monitoring from a distance (1-10 km) will also be investigated, by using existing telecommunication infrastructures.

RADAR
Ground based radar interferometry could be used to monitor face stability during conventional tunnelling and to monitor buildings settlements during shallow tunnelling in urban environment. The radar system could scan the excavation face continuously during operations (field tests will be conducted). Measurements can allow determining displacements at the face, anticipating localised collapse and allowing safer working conditions. The same system could also be used to determine the geometry of the scenario and for geological and structural mapping of the face.
Moreover, radar can be use for assuring safety to buildings adjacent to shallow tunnel excavation in urban areas. Continuous scanning of buildings above tunnel alignment will be performed during construction of Turin ML1. Direct comparison with total station measurements can be made available to allow for improving interpretation scheme and adaptation to the tunnel industry.

Specific requirements (experiences, skills)

The candidate should preferably have knowledge in civil engineering and constructions (Geotechnical engineers are preferable). Skills in monitoring, interpretation of laboratory and field data will be useful.

Website of the research group (if any)

www.rockmech.polito.it

www.optcom.polito.it/PhotonLab

www.linkedin.com/showcase/18122771/

Keywords (min 3, max 6)

Tunneling, monitoring, fiber optics, radar interferometry

Research Area (max 1)

Structural, Geotechnical and Building Engineering