Objective: The aim of this course is to highlight some of the most advanced aspects of digital and information technology applications in the design, construction, maintenance and refurbishment of underground works.

The use of BIM in tunnelling will be presented and discussed, providing students with relevant examples from the design to the "as built" model implemented during construction, in addition to BIM use during maintenance and refurbishment of underground infrastructure.

The second key topic of the course is the use of automation and virtual and augmented reality as tools to improve the tunnel construction process.

Advanced technologies available for geotechnical mapping and exploration, surveying and monitoring will be discussed, together with automation applied to equipment used in underground construction and to quality control and assessment processes.

The course is designed to inform designers, site managers, young engineers and university students how the most recent innovations in information technology can be applied to tunnelling and be used to improve design, construction and maintenance processes.

Day 1: Building Information Modelling in design, construction, operation and maintenance

Session 1: General overview
09:30 – 09:45:   Opening
09:45 – 10:30:   Information technology and digital innovation in construction
10:30 – 11:15   Fundamentals of BIM
11:15 – 11:45:   Coffee Break
11:45 – 12:30:   BIM for underground infrastructure design
12:30 – 13:15:   Specific aspects to be dealt with BIM for underground infrastructure design
13:15 – 13:30:   Q&A
13:30 – 14:30:   Lunch

Session 2: Application of BIM
14:30 – 15:15:   BIM for infrastructure design: Case history
15:15 – 15:45:   Application of BIM: examples
15:45 – 16:15:   BIM application: Case Study
16:15 – 16:45:   Coffee break
16:45 – 17:15:   Use of BIM for tunnel maintenance and refurbishment
17:15 – 17:45:   BIM for the management of mechanized excavation data
17:45 – 18:00:   Q&A

Day 2: Automation in monitoring, surveying and supervision of works and equipment operation

Session 3: Automation in monitoring
09:00 – 09:45:   Type of instruments, data collection, information management.
09:45 – 10:30:   Topographical methods to monitor deformations – GPS, Lidar, InSAR
10:30 – 11:15:   Survey and monitoring with radar satellites: Case history
11:15 – 11:45:   Coffee break
11:45 – 12:30:   Automatic surveying of the rock mass structure in conventional tunnelling. Basic, theory
12:30 – 13:15:   Face monitoring in rock TBM and disk face measurements
13:15 – 13:30   Q&A

13:30 – 14:30:   Lunch

Session 4: Automation in surveying and supervision of works and equipment operation

14:30 – 15:00:   Digitization in full face mechanized tunnelling

15:00 – 15:30:   Automation in drilling equipment. Key issues for choice and design

15:30 – 16:00:   Automation and new technologies in steel arch assembling

16:00 – 16:30:   Coffee break

16:30 – 17:00:   Robot assisted sprayed concrete technology and digital technology for shotcrete training

17:00 – 17:30:   Use of digital technologies and augmented reality for training TBM drivers and workers

17:30 – 18:00:   Perspectives – Contribution of automation for efficiency and safety improvement

18:00 – 18:30   Q&A - Closing remarks