Background

This project addresses the hydraulic resistance of unlined (rough) hydropower tunnels, essential both for power production and flood control. The determination of the hydraulic capacity of such tunnels requires the knowledge of friction factors whose determination is mostly based on empirical approaches. Thus, despite their significance, friction factors can be considered as the weakest component in the design of tunnel waterways.

Methodology and outcomes

This aspect is tackled through a combination of analytical considerations, physical scale model studies, and numerical simulations.

- Novel roughness parameters will be defined on the basis of a statistical analysis of high res. tunnel digital elevation models, obtained through Terrestrial Laser Scanning.
- Friction losses and the flow field measured in scale model studies with miniature versions of the tunnels constructed through computer-controlled milling.
- Assessment of roughness parameters and friction losses with regard to the excavation method => improved protocols for physical scale studies used for the design of tunnels.
- High resolution 3D-numerical simulations validated by extensive PIV measurements on the scale model data.