

## Master thesis

# MAPPING OF KAMMSTOLLEN ON MT. ZUGSPITZE USING SLAM-BASED MOBILE SCANNING SYSTEMS

## Background

The Kammstollen is a tunnel with a length of several hundred meters built inside of Zugspitze, starting at Schneefernerhaus. In 1926 it was drilled into the Zugspitze summit for tourist reasons: Winter sports were just being discovered; skiers should be able to easily get to the German side from the Austrian Zugspitzbahn, to the Zugspitzplatt with its glacier ski area. Today, permafrost scientists regularly examine the tunnel to analyze permafrost. Thus, the Kammstollen and its geometry is of high interest for climate research. Herein, an accurate digital twin of the Kammstollen would enhance related research.



From geodetic view, determining a digital twin of the Kammstollen by mapping the 3D geometry is challenging due to its purely stone structure, partially iced walls, the narrow and long path and various light conditions. Mapping could be performed using static laser scanning combined with point cloud based registration algorithms (e.g., ICP, plane-based) but also using mobile laser scanning based upon SLAM. The issue of registration or point cloud matching, respectively, will be the bottleneck in sense of accuracy.

## Tasks

- Development of a measurement concept to map the Kammstollen – including geo-referencing – using static laser scanning as reference
- Development of a measurement concept to map the Kammstollen – including geo-referencing – using mobile SLAM-based laser scanning
- Performing the laser scans using static laser scanning and two different SLAM-based scanning systems (Z+F Flex Scan, BLK ARC); with the latter ones, the Kammstollen should be scanned several times for evaluation purposes
- Developing a concept to evaluate the quality of the derived point clouds (accuracy, precision, density) by comparison amongst the different systems and by comparing several proceeding attempts
- Revealing and mitigating potential drift effects in the point clouds due to the open traverse character of the Kammstollen
- Generating a final quality-controlled and geo-referenced map of the Kammstollen, potentially by merging different point clouds

## Supervisor

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