SUCCESS STORY

SCCH
Software Competence Center Hagenberg GmbH

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre (K1)

Typ of project: TransMVS 2019 – 2022, multifirm

Track tamping machine Plasser & Theurer (©Plasser & Theurer, 2022)

EVERYTHING ON RAIL

KI-SUPPORTED, PARTIALLY AUTOMATED TRACK INSPECTION AND MAINTENANCE INCREASES SAFETY IN RAIL TRAFFIC

The inspection and maintenance of railway tracks is essential for the safety of rail transport. This can be achieved by making use of so-called tamping machines, that compact the ballast under the rails at defined points of the track system to ensure a high density and to reduce vibrations.

Higher ballast density, higher safety

These tamping machines are equipped with laser sensors that digitally map the tracks and generate 3D point cloud data. Using the digital data, the machine automatically stops at predefined positions where tamping is needed. The machine operator checks the process to avoid damage. Various sensors are used to make this point cloud data as accurate as possible to avoid deviations and thus, damage to the machine as well as to the track. The global track scene is recorded in reduced resolution while the rails are recorded in high resolution. The data from the different sensors must then be registered with each other and transformed into a world coordinate system so that the tamping points can be calculated exactly.

Semi-automated registration of sensor data

Usually, registration was done manually by measuring the distances and angles of the different sensors and thus, determining the transformation matrix necessary for the registration of the different sensor data. This process is time-consuming and requires specialised personnel. Track Machines Connected (TMC) and SCCH jointly researched methods and solutions to replace the manual, time-consuming registration with a semi-automated process. In order to combine data from multiple sensors, a multi-sensor registration problem had to be solved. This is not a common procedure for 3D point cloud data used in automation such as mobile robotics.

Registration of point cloud data from different sensors

Registering point cloud data becomes problematic when there are no unique positions in the scene to be digitised (landmarks, which are reference points that can be used to determine the transformation between point cloud data). The problem was exacerbated because the different sensors generated data with different characteristics. The biggest hurdles were locally uneven noise behaviour, outliers in places, differences in point density due to the inconstant driving speed of the machine, unequal shapes of the same objects in the point cloud data due to the different viewing angle of the sensors, and only partial overlap between the data areas. The registration problem was solved by generating an artificial reference in all data using calibration objects – digitally created, manufactured and placed near the track specifically for the project. It was ensured that each high-resolution sensor contained a calibration object in the field of view, and that the scanner capturing the global scene captured all calibration objects. The problem of different point cloud data was solved by creating manually registered point cloud data in a reference dataset – this allowed each calibration object to always be registered with the one in the reference dataset to avoid cross-sensor registration.

Knowledge transfer and leapfrogging

The shared knowledge on the analysis and registration of 3D point cloud data led to a knowledge advantage in this field.

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This success story was provided by the Software Competence Center Hagenberg and by the mentioned project partners for the purpose of being published on the FFG website. Software Competence Center Hagenberg is a COMET Centre within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, Upper Austrian Government. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet