Cost-effective Localization of Railway Track Faults using GNSS Antenna under Train's Roof

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SUMMARY

Since 2023, the Institute of Engineering Geodesy (IIGS) and the Institute of Railway and Transportation Engineering (IEV) at the University of Stuttgart have been working together on the German Research Foundation (DFG) project ConMoRAIL (Efficient Sensor-Based Condition Monitoring Methodology for the Detection and Localization of Faults on the Railway Track). The first results of IIGS's contribution to the localization of railway track faults are the main topic of this paper.

After the project ConMoRAIL is introduced, the system requirements and setup will be introduced. Challenges regarding the GNSS (Global Navigation Satellite Systems) positioning technology will be explained. Extra permission is necessary if the GNSS antenna is placed on the top of the train. Aiming to develop a permit-free system, the GNSS antenna is placed under the train's roof.

One cover plate using the same material as the train's roof was constructed to investigate the effect of the train's roof on the GNSS measurements. In the first step, static measurements were conducted, and the results were presented and analyzed. Then, kinematic measurements were realized directly on the train. The cost-effective Inertial Measurement Unit (IMU) was also integrated into the system, and an error state Kalman Filter (ESKF) was implemented to integrate GNSS and IMU data. The results with and without integrating the IMU will be illustrated and analyzed. Finally, future work will be discussed.