A camera shake correction method for optical measurements in railways based on IMU sensors

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Introduction

Environmental conditions such as wind and ground traffic introduce motion in camera measurement systems and affect measurement accuracy. Conventional camera shake correction methods track static reference points with one or multiple cameras, reducing applicability. A novel 6-degree-of-freedom (DOF) camera shake correction method [1] was proposed using only an inertial measurement unit (IMU) sensor. Six pinhole camera models were built to evaluate and correct 6-DOF camera motions, which include roll, pitch, yaw, surge, sway and heave. The workflow is shown in Figure 1.

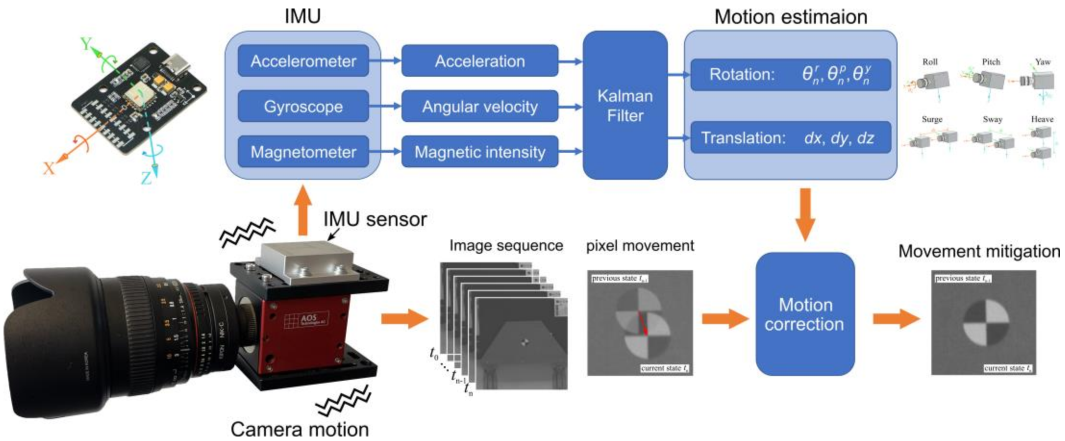

Figure 1. A 6-DOF camera shake correction method using only an IMU sensor.

Validation and Conclusions

The camera shake correction efficiency and robustness were tested for different object distances between 3 and 12 m and two optical lenses with focal lengths of 50 and 100 mm. The correction ratio is statistically analysed and reaches approximately 80%. The object distance has little effect on the shake correction ratio. The proposed camera shake correction system has the advantages of low cost, high efficiency and a simple layout, increasing the applicability and robustness of optical measurements in railways and addressing the dependence of conventional methods on fixed reference points.

References

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Dynamic interaction between pantograph and catenary – possible applications for simulation tools

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Abstract

The dynamic interaction between the pantograph and overhead catenary line (OCL) is crucial for safe and reliable railway operation. Simulation tools are being used and further developed as a means to understand and optimise designs (Bruni, 2018). In Sweden, the simulation tool CaPaSIM was created in the late 90s and has been used and developed since at KTH and Trafikverket (Jönsson, 2015).

This automated and updated version of CaPaSIM 3D is currently being validated according to EN 50318. The first results of this validation process show that CaPaSIM 3D accurately represents the dynamic interaction behaviour of the pantograph and OCL. However, they also reveal the sensitivity of the results to the model setup. Especially for the operation with multiple pantographs at high speeds, the choice of element types and the adjustment of structural damping coefficients strongly influence the results.

In addition to validation work, the simulation tool has been used to formulate an improved calculation method for the ideal level of pre-sag in the design process of simple OCL systems for use in the quasi-static regime. Another application is the study of wear intensities during the operational cycle of a railway pantograph. In the latter, implications of the three-dimensional interaction dynamics and traction simulations were combined to identify the most critical operational stages for wear and the resulting patterns on the collector strip. Finally, the tool is currently used to verify Sweden's new high-speed catenary system design. The focus of this study is the identification of suitable pantograph distances for multiple operation in overlap sections.

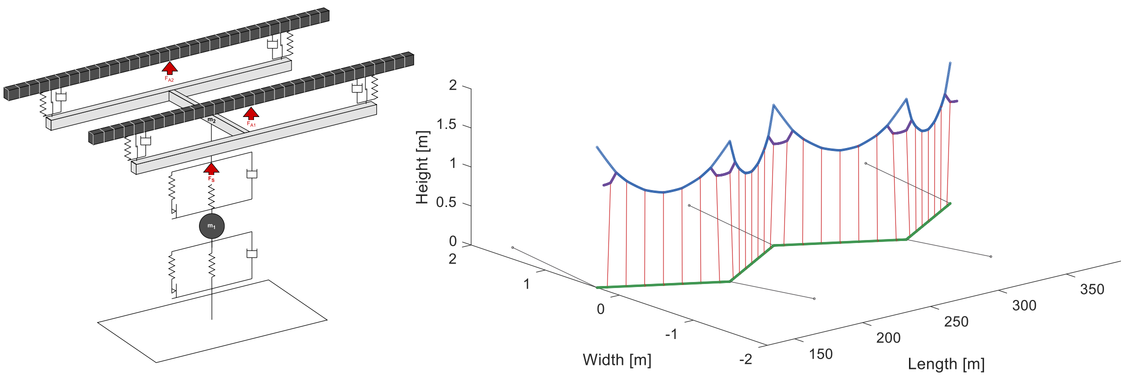

Figure 1: Model representations of the pantograph and catenary structure in CaPaSIM 3D.

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