Performance Evaluation of a Purpose-Built, Low-Cost, Multi-Sensor Platform for Supporting a Truck Driver Coaching System

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SUMMARY

This paper elaborates on the performance evaluation of a custom-built, low cost, multi-sensor measurement system employed to serve as the backbone for setting up an advanced truck driver coaching system. The proposed sensor platform aims at retrieving, processing and analyzing a multitude of heterogeneous field data (i.e., location, kinematics, ambient conditions, vehicle functional characteristics, etc.) in order to compute and compare the running state of the target vehicle against a set of reference values derived using BI (Business Intelligence) analyses and long-standing historic data. The outcome of this ongoing process reaches the user in a stream of suitable audio proposition updates to ensure a safe and efficient as possible drive.

Recently, a continuously increasing number of low-cost, high capability micro sensor systems, including GNSS/IMU modules, have broadly flooded the market. This has motivated the integration of such sensors with data streams drafted from the CAN bus of a truck, and processing them all together using cheap Arduino-like processing units in real-time. However, the low-cost state of such modules and compatibility issues arising from their coupling with the CAN bus information dictates careful selection of individual sensor components and extensive testing of the raw data quality. To this effect, the evaluation strategy proposed in this study is twofold. Firstly, a primary dataset was acquired and analyzed using the default SPP solution, of a low-cost GNSS receiver to serve as a baseline for evaluating further improvements. In order to achieve better positioning performance in terms of continuity and precision, the built-in GNSS/IMU fused positioning solution was utilized. This attempt relied on appropriate tuning of the positioning system for mitigating errors resulting from application-specific challenges (GNSS signal loss in tunnels, satellite shadowing due to sensor placement limitations, etc.). Secondly, specific parameters were recorded via the vehicle CAN bus and decoded in order to extract its kinematic state. The recorded time series derived from both steps (positioning solution, odometer, wheel speed, etc.) are then analyzed and evaluated in terms of precision and correctness, against a reference navigation solution generated by a high precision GNSS/INS system. Highlights of the strengths and weaknesses concerning the investigated sensor set capabilities and options point out possible system refinements and future development.