Aufgabenstellung für eine Masterarbeit

„ An Integrated Estimator for Online Vehicle Mass and Road Slope based on IMU “

for Ms. / Mr. First name Surname, Registration No.: XXXXXX

A significant number of mass estimation algorithms have been developed with longitudinal dynamics. However, most of these approaches are based on the method of constant vehicle mass and time-varying road grade. Although both vehicle mass and road grad could be identified, the nature of time-varying road grade could lead to significant disturbance for the precision of vehicle mass estimation. In addition, parameters including rolling resistance, drag coefficient and wind velocity are necessary, which also should be estimated. Consideration of the limitations about estimation approaches, a novel approach will be proposed in this task.

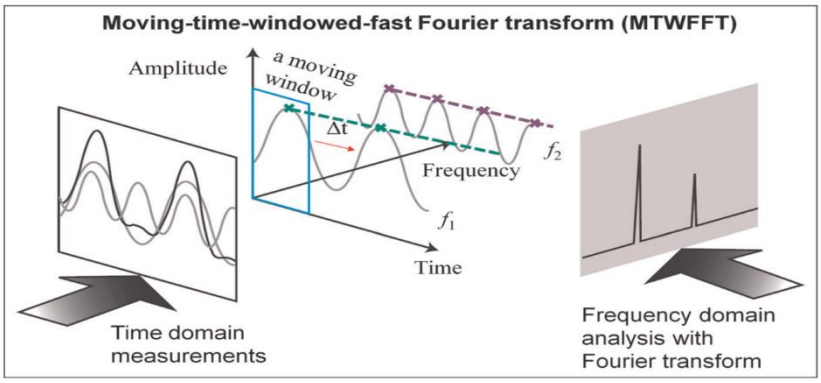

Figure 1: Principle of the Time-frequency Analysis MTWFFT

In order to decouple the coupled influence of road grade on vehicle mass estimation, this task proposed a novel method for vehicle mass estimation based on frequency-information-extraction. Figure 1 shows that the principle of the MTWFFT method. Normally, the dynamic signals are directly obtained from measurements in the time domain. This task adopts vertical acceleration and angular velocity from IMU measurement which treats the vertical acceleration of the body mass as inputs in the dynamic equations.

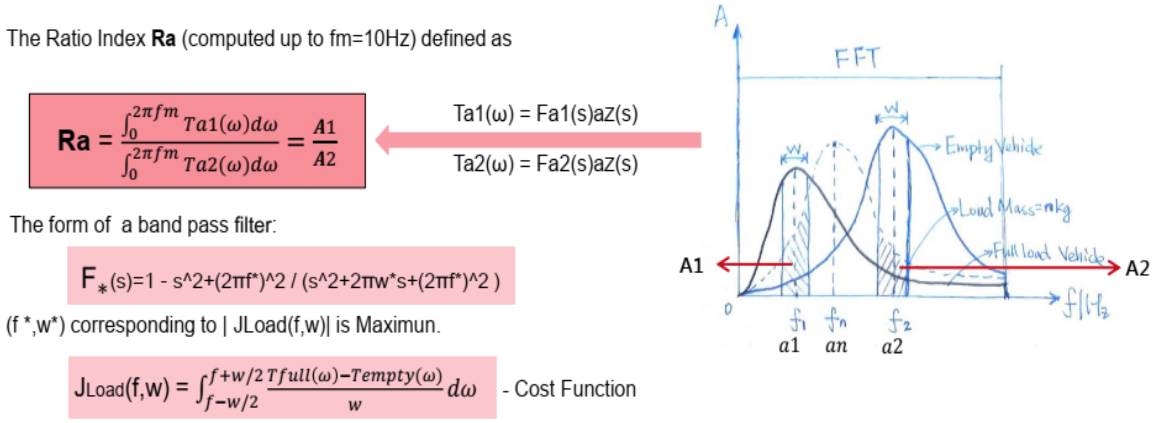

Figure 2: Spectra of the vertical acc. for different loading mass and the ratio index

The estimation approach is based on the observation that the frequency spectrum of the both the vertical accelerometer and the motions angular rate significantly varies as a function of the vehicle

loading mass and its distribution. This can be indicated by the instruction in Fig. 2, which shows the ratio index and the accelerometer spectra obtained where the same vehicle is facing the same road profile, but with different loading mass, located in the same position inside the vehicle.

Major Responsibilities:

- Simulink modelling of vehicle dynamics and kinematics system based on different road profile, then vehicle body movement signals were collected, processed and filtered respectively, and body mass acc. and angular rates which as the inputs of the ratio index.
- Simulation based on Simulink model with ANN estimators which will be developed, mainly focus on the novel ANN algorithm.
  1) Developed ANN estimator for the vehicle body system to identify the loading mass with the ratio index.
  2) For training the ANN Estimator, we choose variable loading mass under different road profile conditions, until the estimated results match with the real one well.
  3) After finished training, then we test any loading mass under random road profile.
- Evaluation for the simulation results of the ANN algorithm.
- Validation about the estimation algorithm in CarMaker-Simulink co-simulation.

We are looking for:

- Good academic background
- Experience in MATALB / Simulink
- Fluent in writing & speaking English
- Good at vehicle dynamics and control algorithm
- Familiar with artificial neural network control algorithm.

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