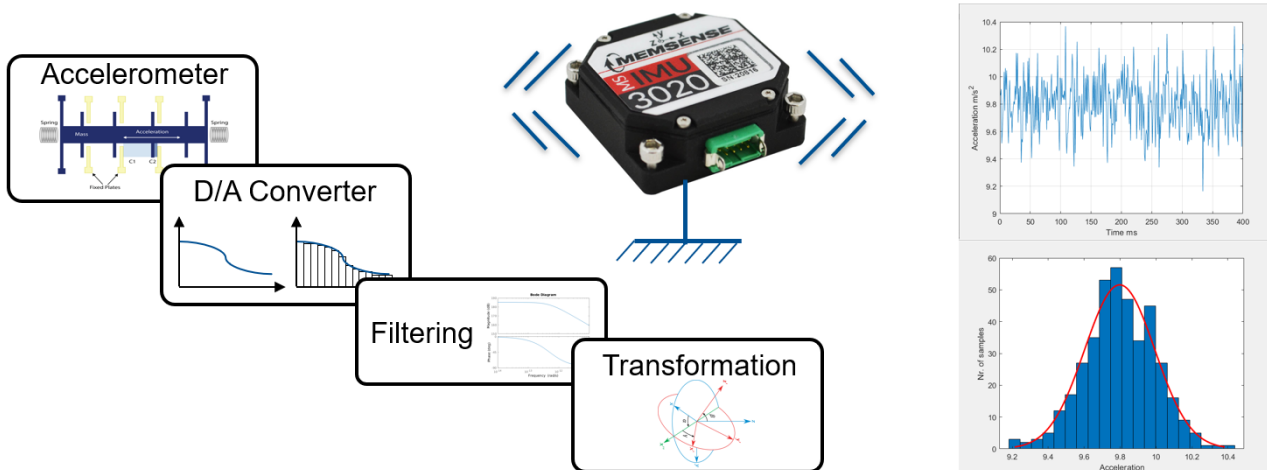# Vibration-environment measurement and classification for agricultural machines

Background

The chair of agrimechatronics is currently searching for a semester's or master's thesis student to work on the classification of vibrations during the operation of agricultural vehicles. This thesis includes the design of a rugged measurement setup, algorithmic analysis, and classifications of the vibration environment.

Thesis task

Unlike on-road, off-road vehicles such as agricultural machines (tractors, combine harvesters, sprayers, etc.) operate on unstructured and uneven terrain. As a result, the machines are affected by significant vibrations, which vary over time due to differences in the operating environment, the machine's working status, and more. Since vibrations are a driving aspect for fatigue and greatly influence sensor readings, the type and strength of vibrations for a defined set of operations are of interest and should be classified within this thesis. To this end, the following tasks are to be solved:

Part A: Measurement platform prototyping (30%)
1. Review of IMU operating principle (including sampling frequency, accuracy, and filters)
2. Implementation of a data-capturing platform on preferably a 32bit microcontroller
3. Hardware design (prototype level) for a protective case with simple mounting capabilities

Part B: Data collection (10%)
1. Planning of a short-term data collection campaign with the formulation of desired goals
2. Calibration of the sensor
3. Participating in the data collection (with the help of technicians)

Part C: Post-processing (60%)
1. Raw-data post-processing (unit conversions, transformation to vehicle frame)
a. Data analysis with scope to main frequencies, amplitudes, and variations
b. Classification criteria establishment for different scenarios
c. Validation of the classification criteria

General

The theoretical part of the thesis can be done at your own pace and in your favorite working environment. Regular meetings (weekly or biweekly) with the advisor are compulsory. For developing and prototyping the vibration logger, the electronic lab of the chair in Dürnast (close to Weihenstephan, Freising) and various 3-D printers for the housing are available. Preliminary tests on agricultural machines are feasible with different vehicles in Dürnast.

A profound motivation for the topic is the only requirement for working on this thesis. Previous experiences in microcontroller programming, vibration analysis, or statistics will help you but are optional initially. As a benefit, we offer a high degree of freedom during the thesis for your personal preferences and solution strategies. This, in turn, requires structured and independent work. The topic above was sketched for a master's thesis but can also be adapted to fit a semester's thesis.

Interested? Contact us!

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