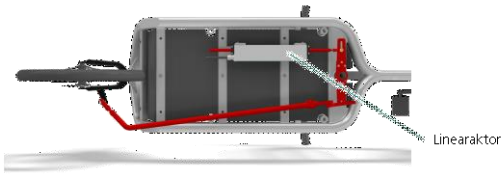
ARP –Advanced Research Project

Experimental evaluation of dynamic parameters of a cargo bicycle and design of self-stabilizing active control strategy.

Supervisors: Moritz Hülsebrock, M. Sc., Dr. –Ing. Giovanni Lapiccirella
Begin: ASAP
Requirements: Structure dynamics, control engineering and mechatronic systems

At the Department of System Reliability, Adaptronics and Machine Acoustics SAM, methods are researched to describe and evaluate complex smart structure systems. In the frame of the project *Lasten-Leichtbaufahrrad "L-LBF",* a lightweight cargo bicycle with embedded sensors and active systems has been developed. A key technology for this purpose is represented by the active self-steering/stabilizing system. The aims of this system are to provide higher stability to cargo bicycles, which suffer of poor self-stability when a load is present on the front space. For this purpose, the bicycle has been equipped with an "Inertial Measurement Unit (IMU)" to measure bicycle orientation, a potentiometer on the steering axis to measure steering angle and rates, a Hall-effect sensor at the rear wheel to measure bicycle speed. A servo actuator on the bottom of the bicycle is installed to control the steering wheel movements with a signal processing and rapid prototyping platform for the implementation of the control strategy. A Simulink simulation model of cargo bicycle dynamics has been realized for designing the active control strategy and for studying the effects of the active control system to the bicycle. However, the bicycle parameters used are those for a standard bicycle. In order to obtain suitable control parameters, the bicycle model needs to be described with higher precision. Therefore, the aim of this ARP is the experimental evaluation of parameters of the cargo bicycle model and active control design for the self-stabilizing function. The tasks to be performed in this project are:

- Experimental evaluation of cargo bicycle inertial and structural parameters under different conditions;
- Update of the nonlinear Simulink model describing the cargo bicycle dynamics;
- Literature research on self-stabilizing/steering control strategies (e.g. adaptive State-feedback etc.) and robust control (e.g. mu-Synthesis, H-infinity etc.);
- Evaluation of most suitable control approach/strategy and design of a control strategy;
- Documentation and presentation of the results.



Contact person:
Dr.-Ing. Giovanni Lapiccirella
✉ giovanni.lapiccirella@lbf.fraunhofer.de
☎ 06151 705-8517
D015 Fraunhofer LBF

gültig bis: 30.4.2021