

Robust control of a direct-drive electromagnetic active suspension system

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Where innovation starts



The ultimate goal...



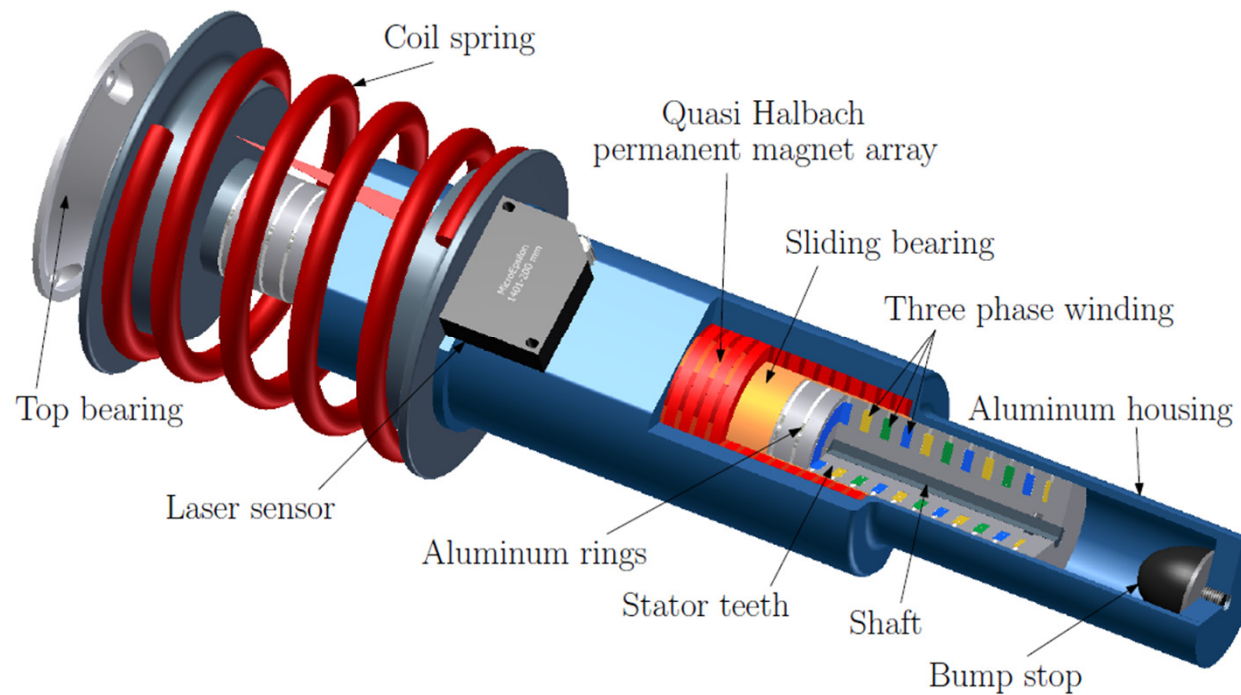
Comfortable as a Rolls Royce



Handle like a Ferrari

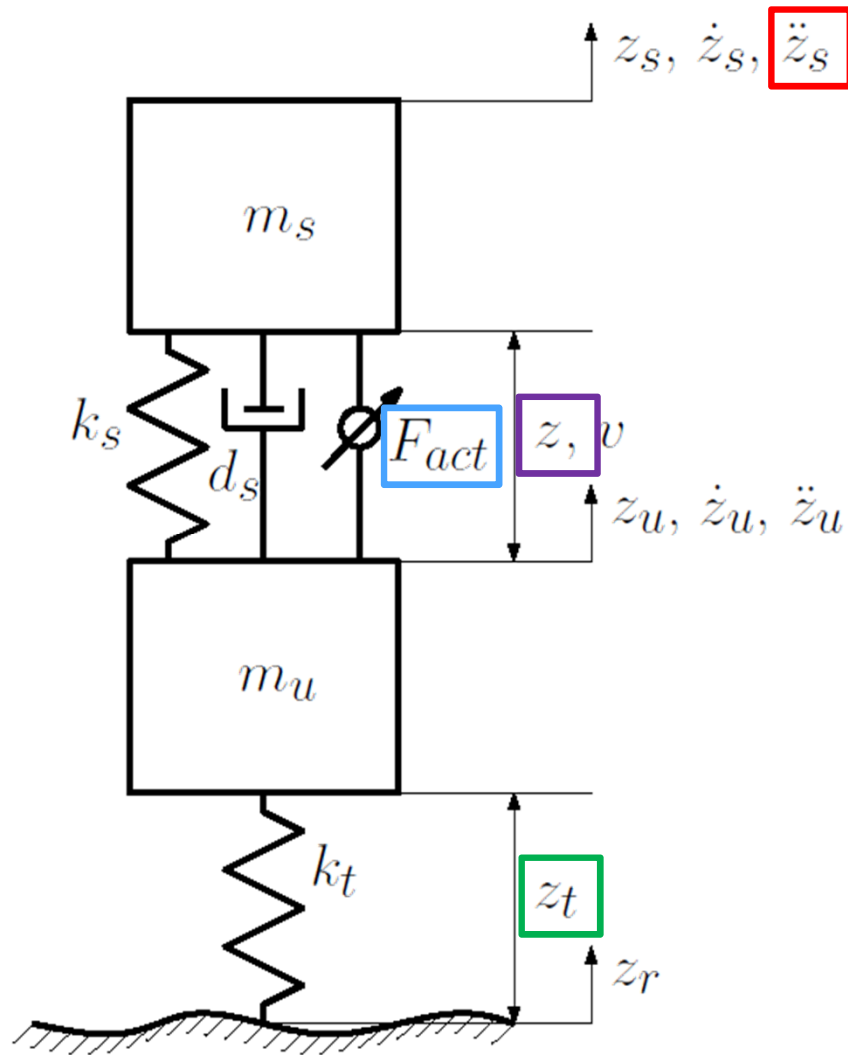
The solution

Active suspension!



How to control this?

Quarter car



Control for comfort:

- Minimize vertical acceleration of vehicle body.

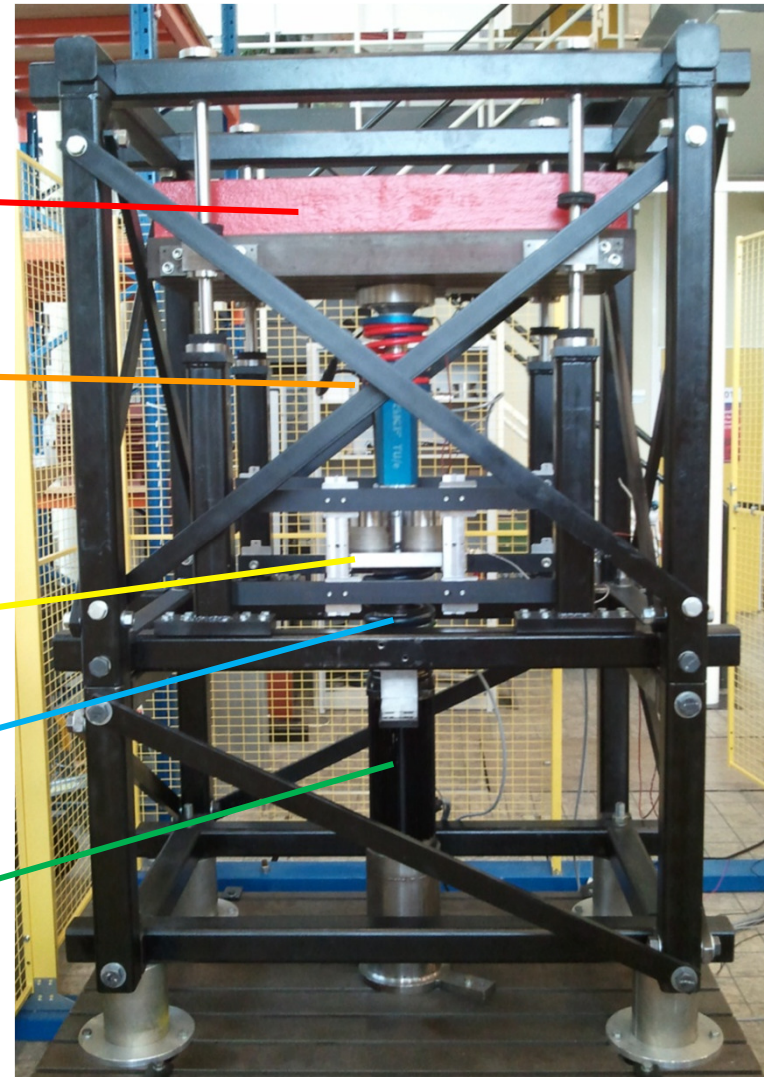
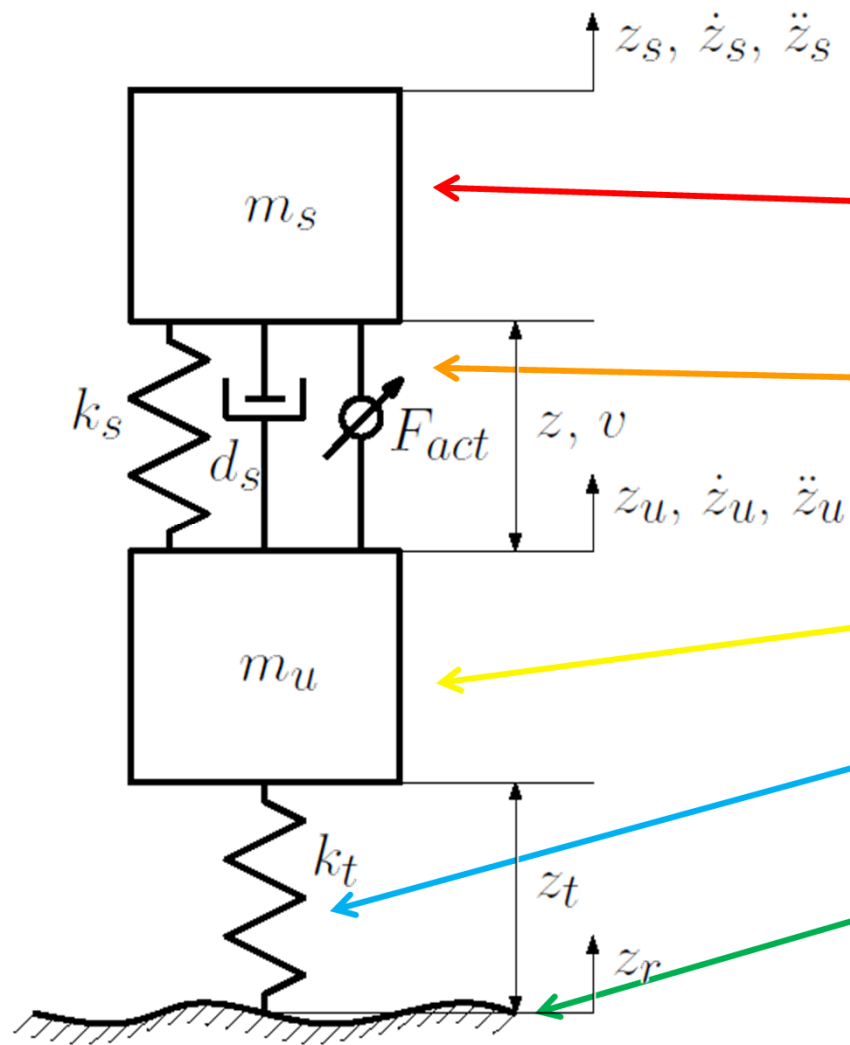
Control for handling:

- Minimize tire compression.

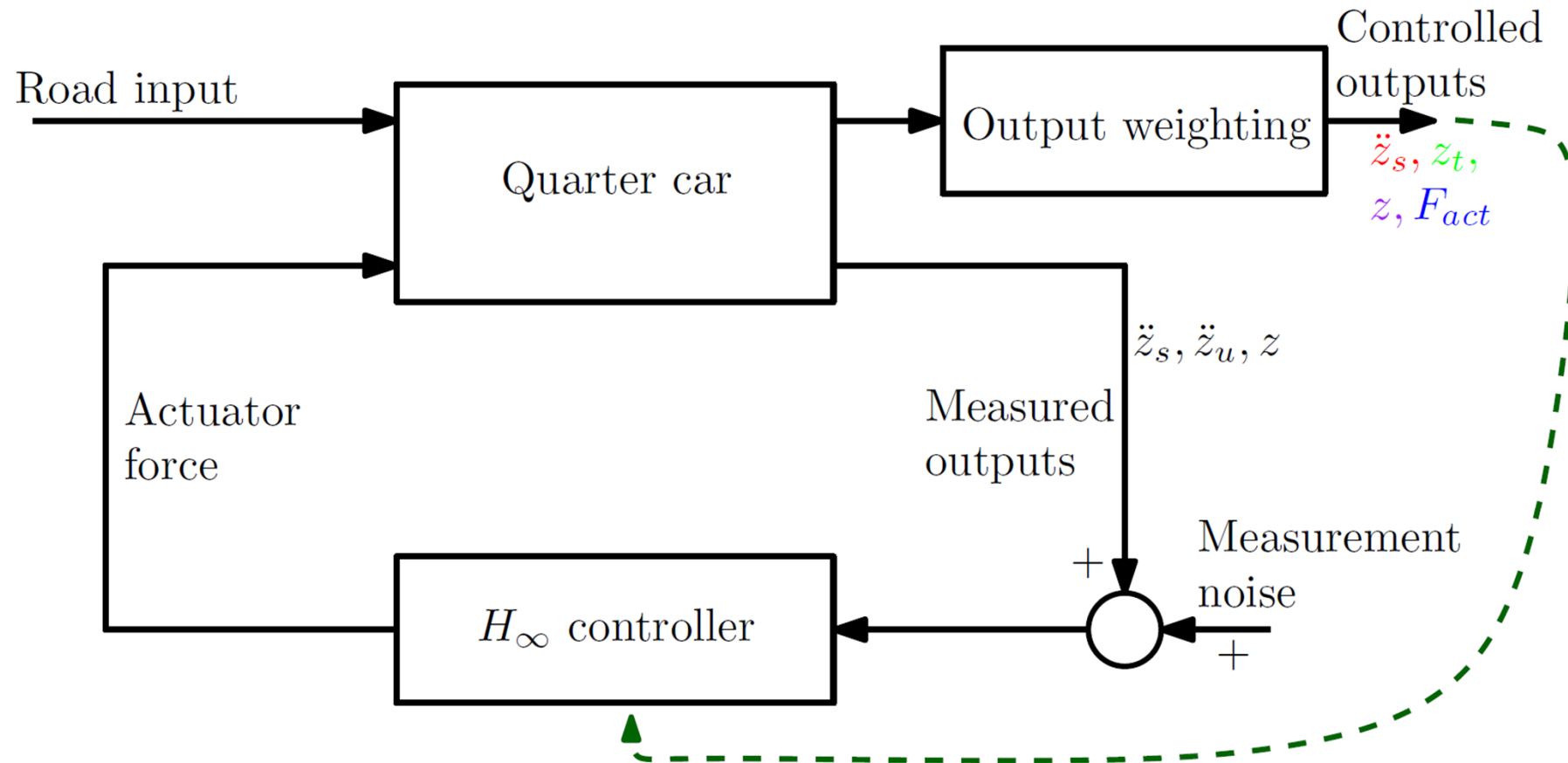
Boundary conditions:

- Limited suspension travel.
- Limited actuator force.

Test setup

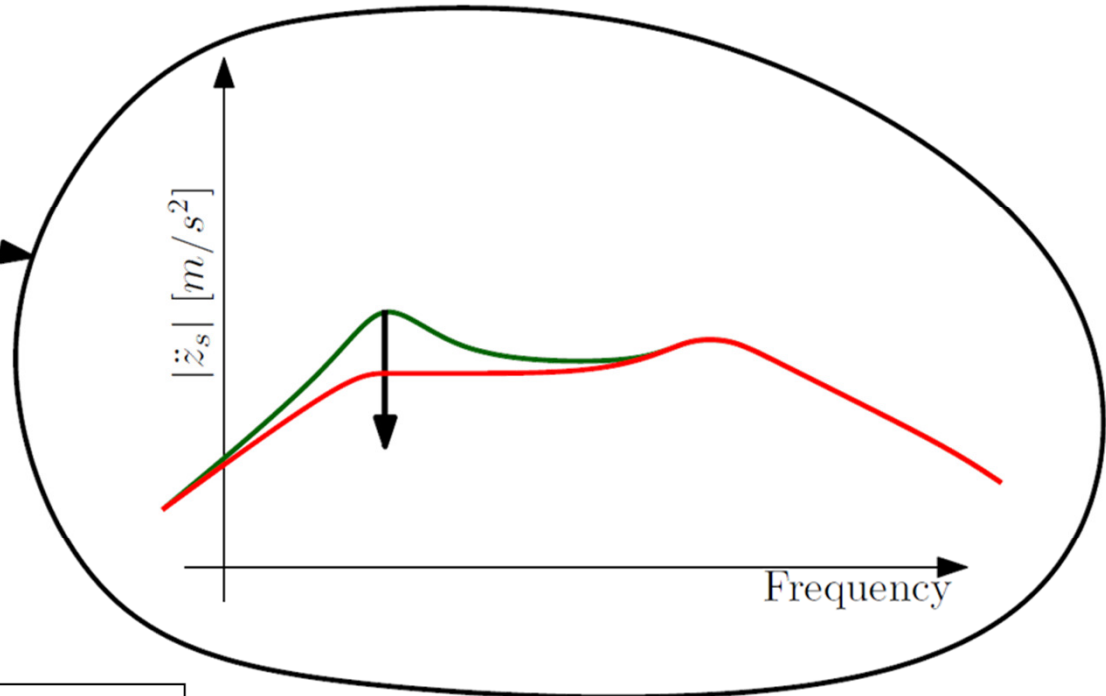
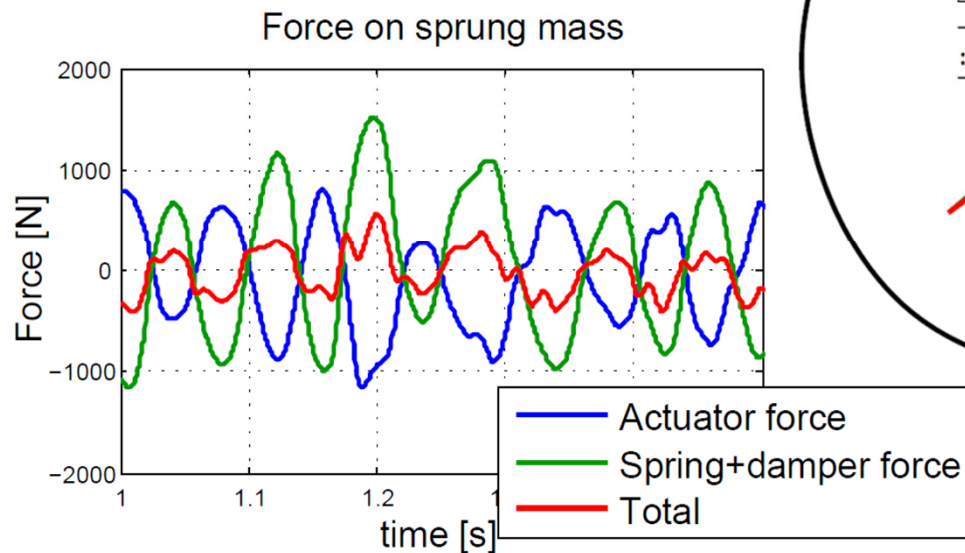
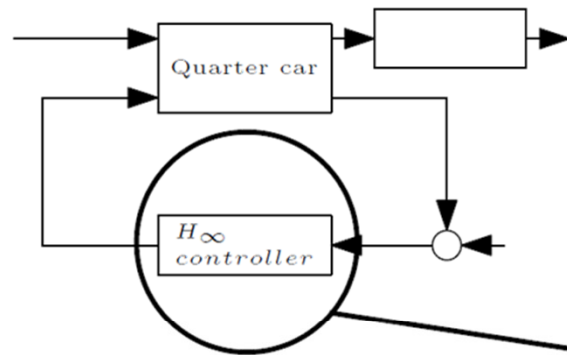


Controller



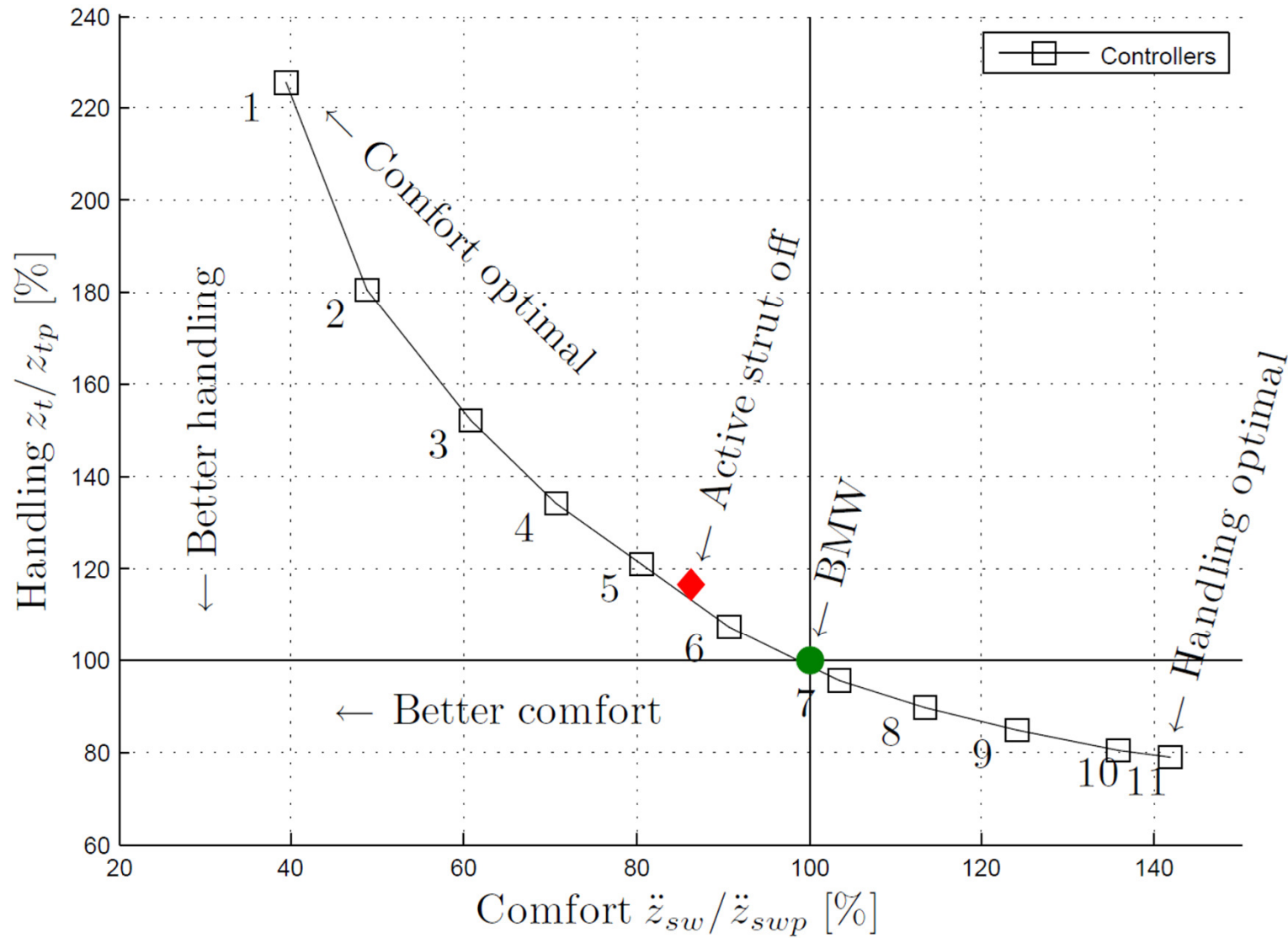
Output weighting is done to put emphasis on either comfort or handling whilst keeping both suspension travel and actuator force within limits.

H_∞ control

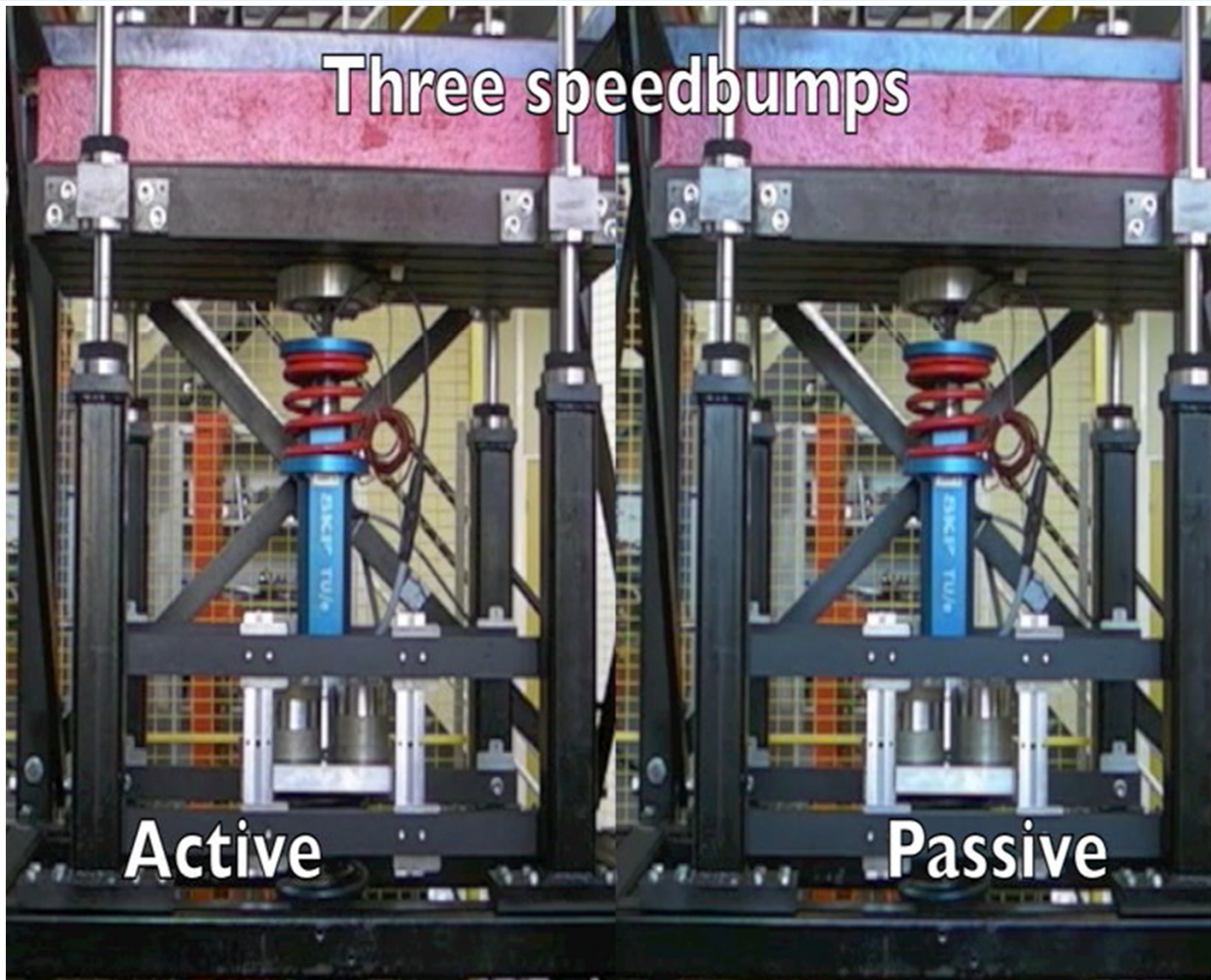


An H_∞-controller takes into account the worst case plant and tries to minimize the peak value over frequency.

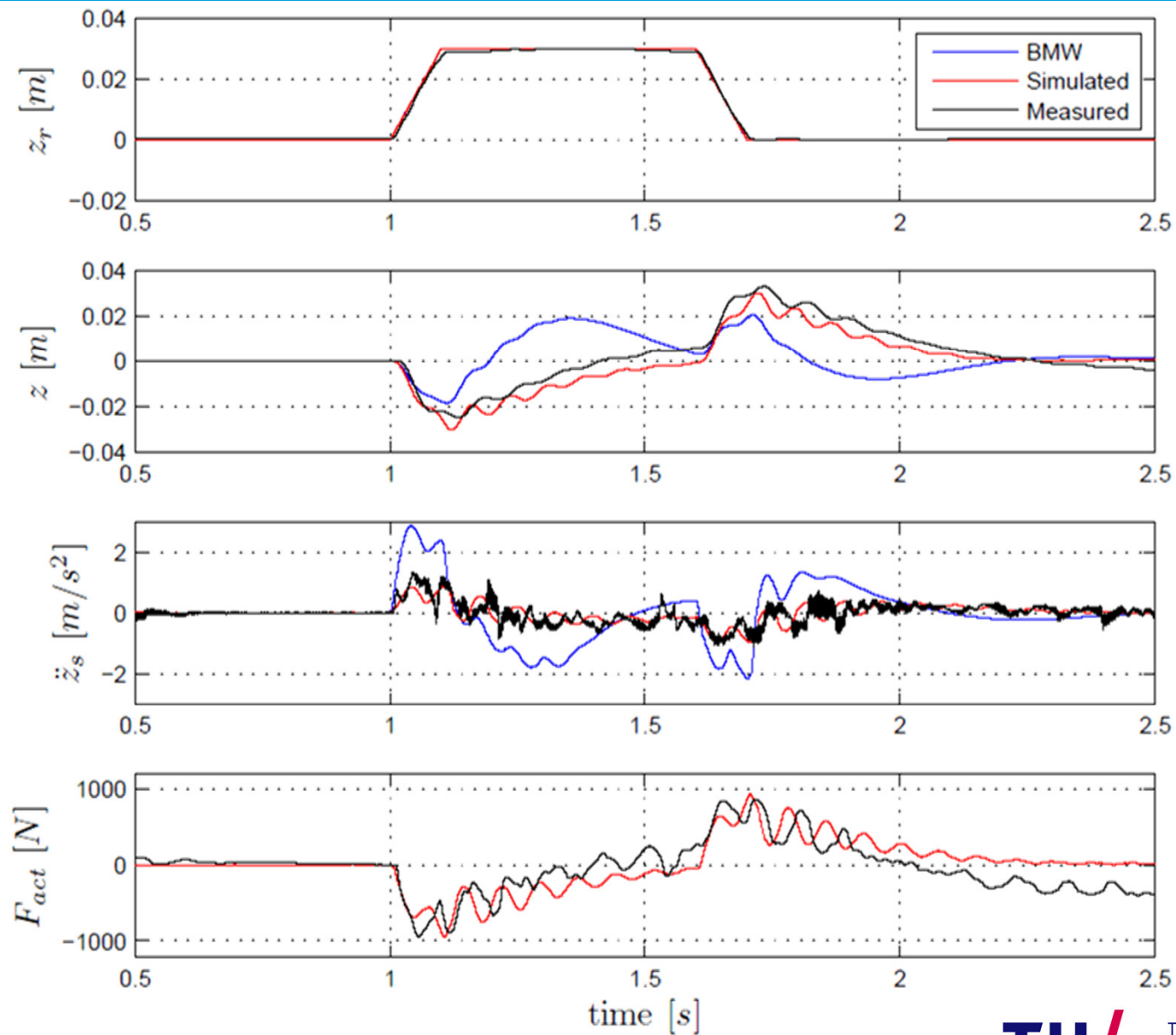
Handling/comfort trade-off remains



Results: 3 cm speedbump



Results: most comfortable setting



Conclusion

- Comfort can be improved up to 53% over a speed bump.
- A dynamic tire load improvement of 21% compared to the normal BMW can be achieved with different controller tuning.
- Good correlation between simulation model and test setup is achieved.
- Lower power consumption compared to commercially available systems is achieved (Power consumption $<100\text{W}$ on rough roads).
- Stability of the system is guaranteed under changing vehicle parameters.

Outlook



Questions

