



Optimalization of control algorithm of MR damper

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 **ústav
konstruování**

Theory is when one knows everything but nothing works. Practice is when everything works but nobody knows why. In our lab, theory and practice go hand in hand: nothing works and nobody knows why.

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Faculty of Mechanical Engineering
BUT

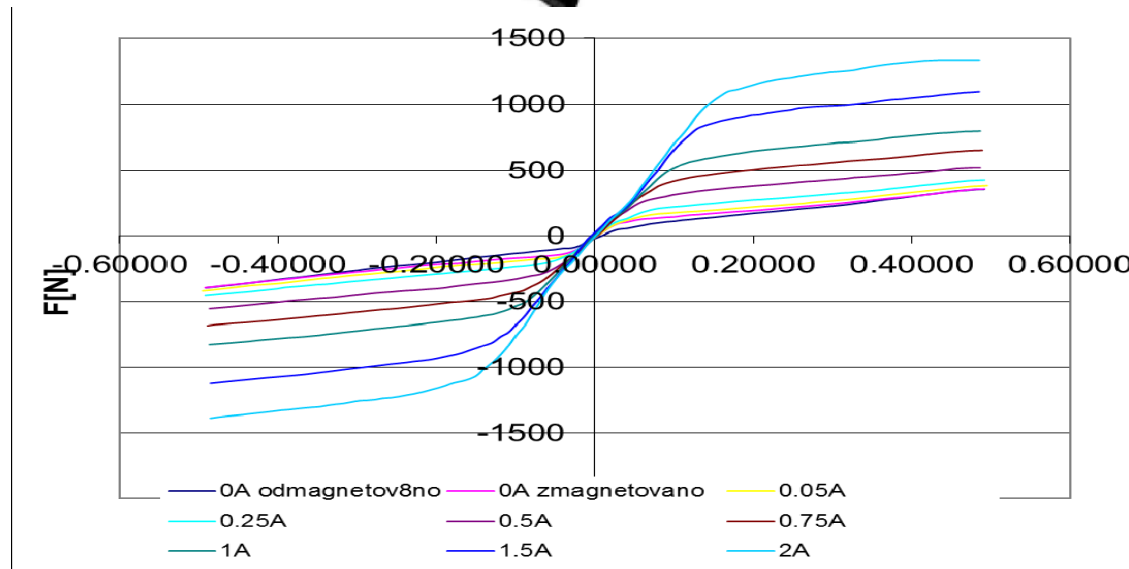
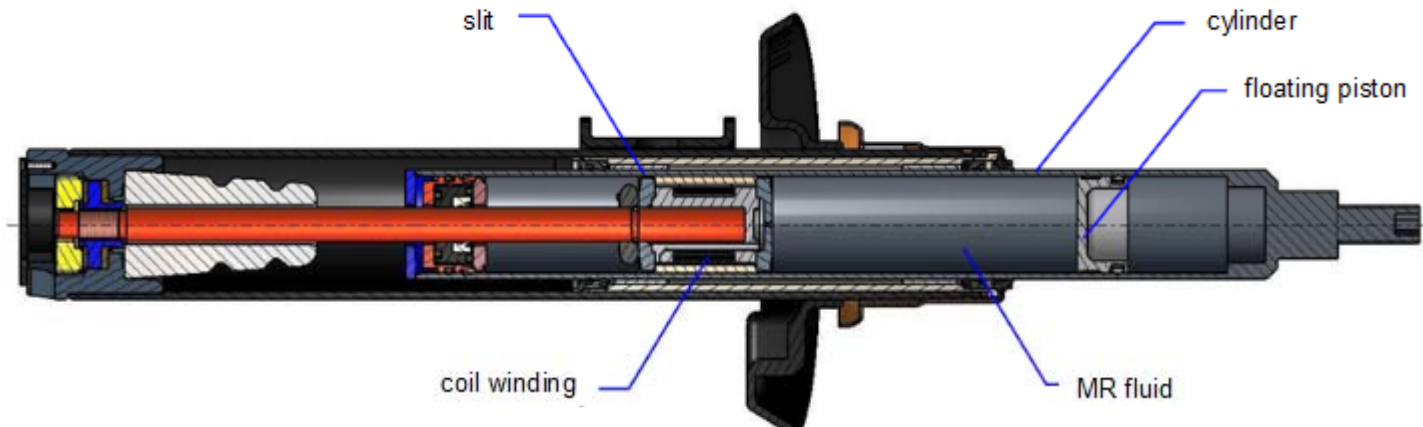
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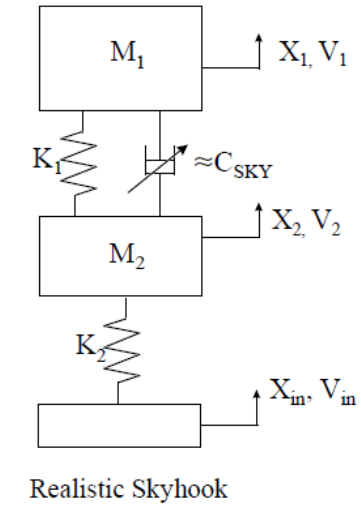
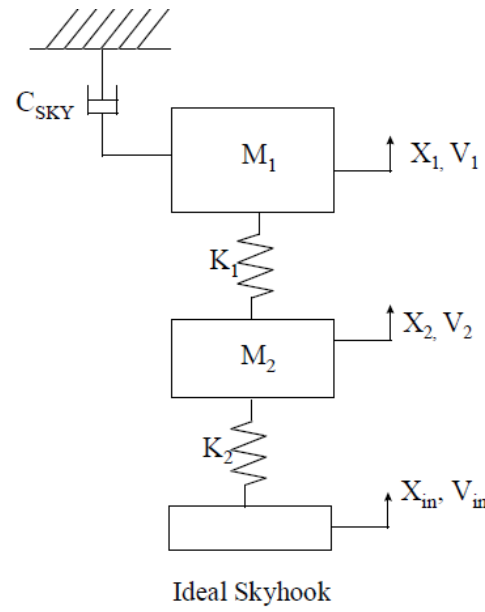
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Optimalization of control algorithm of MR damper

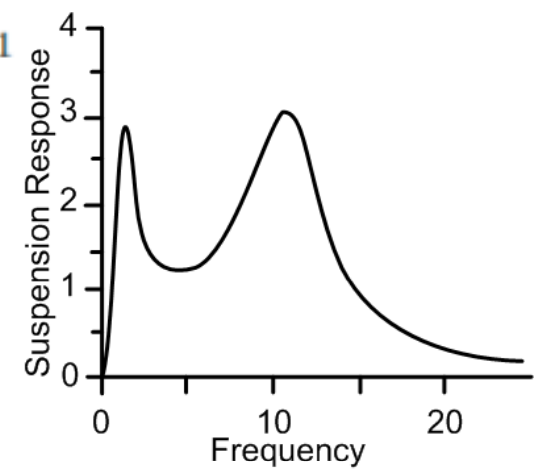
MR damper





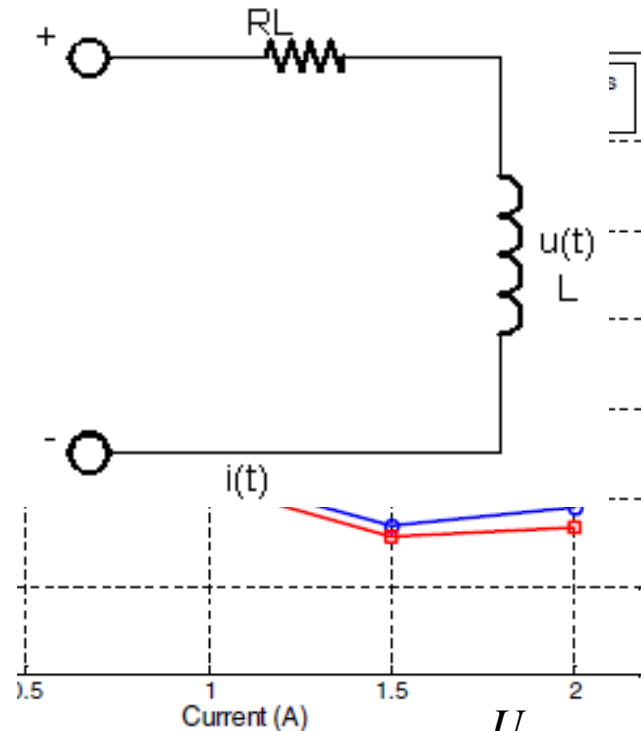
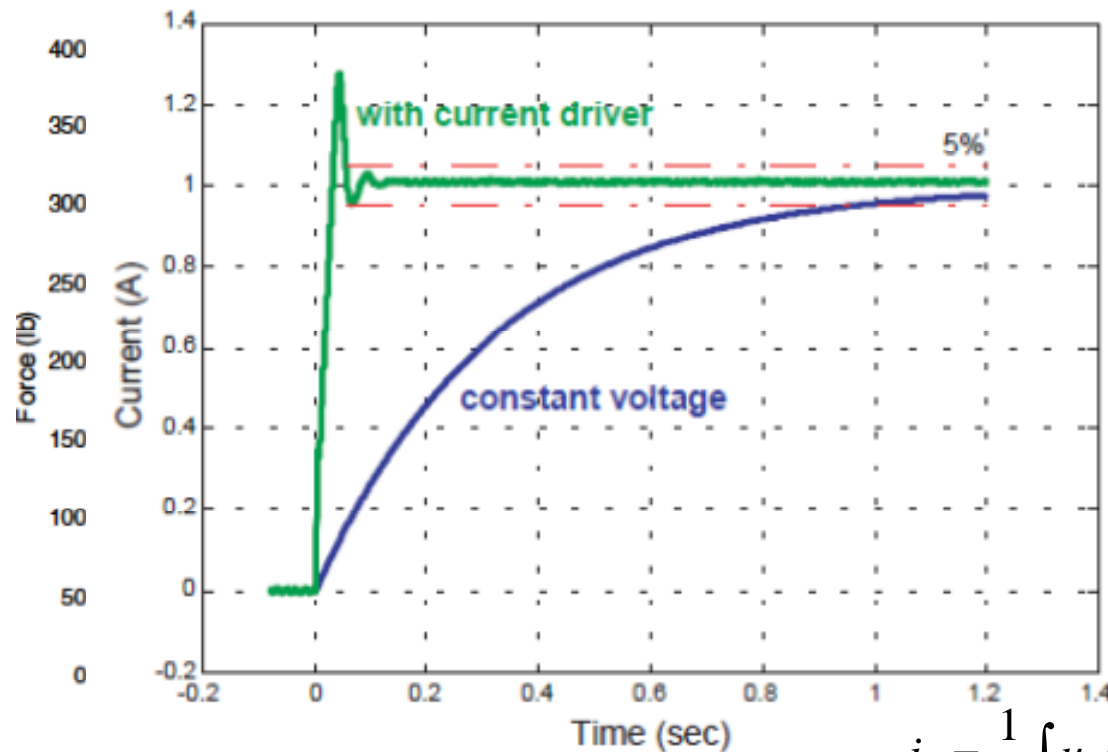
$$v_1 v_{12} \geq 0 \quad F_{sa} = c_{sky} v_1$$

$$v_1 v_{12} < 0 \quad F_{sa} = 0$$



Current state of art

- A comprehensive analysis of the response time of MR dampers (Apr 2006) Jeong-Hoi Koo, Fernando D Goncalves, Mehdi Ahmadian,
- Dynamic modeling of large-scale magnetorheological damper systems for civil engineering applications (october 2003) Guangqiang Yang, Billie F. Spencer, Jr, Hyung-Jo Jung, and J. David Carlson



$$i = \frac{1}{L} \int u(t) dt, \quad u(t) = i \cdot R_L \Rightarrow i = \frac{U}{R_L} (1 - e^{-\frac{R_L t}{L}})$$

Optimalization of control algorithm of MR damper

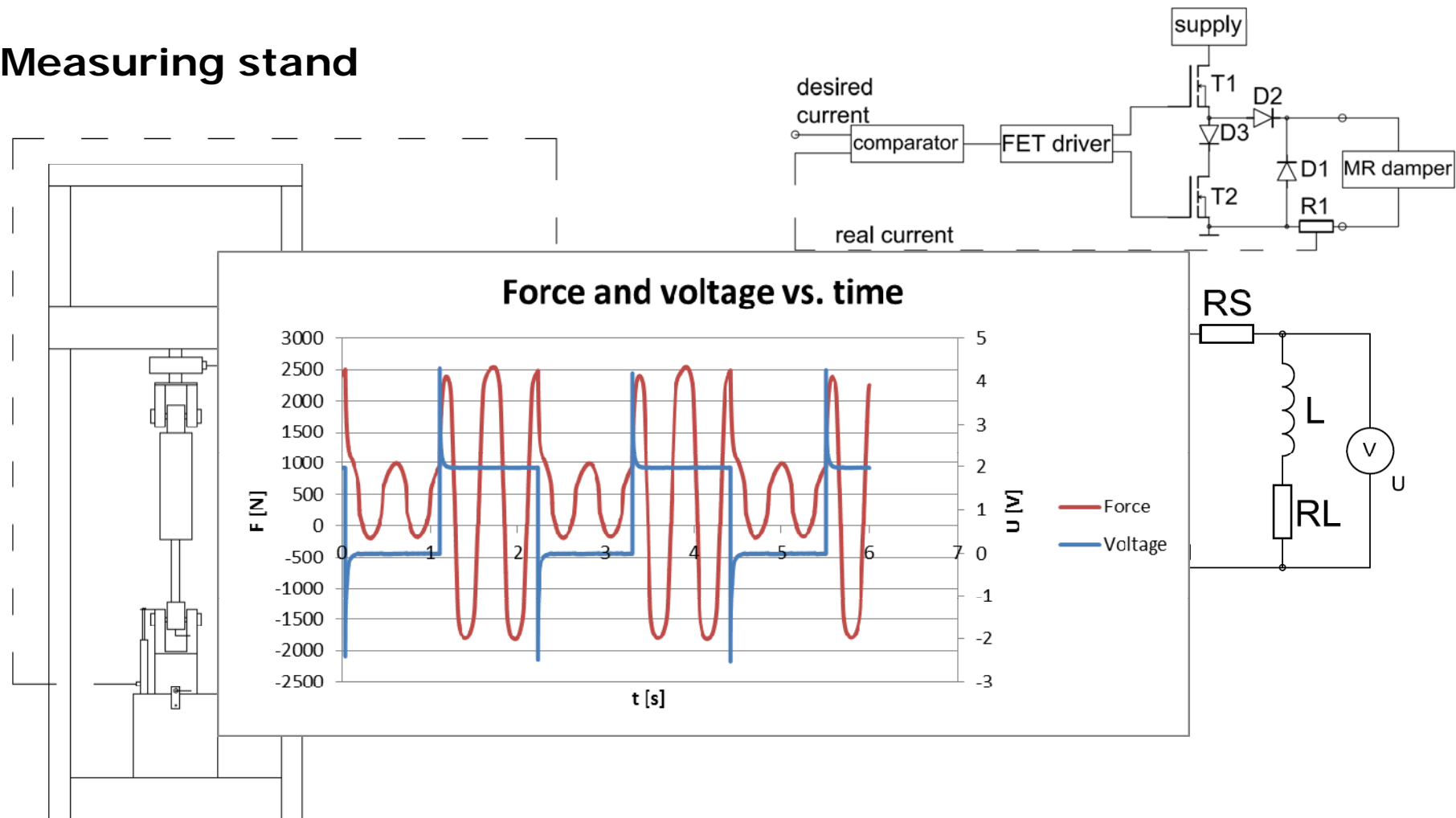
AIMS

- To measure time response dependances
- To find sources of the long time response
- To design optimized controller
- To use and compare suspension quality with advanced control algorithms

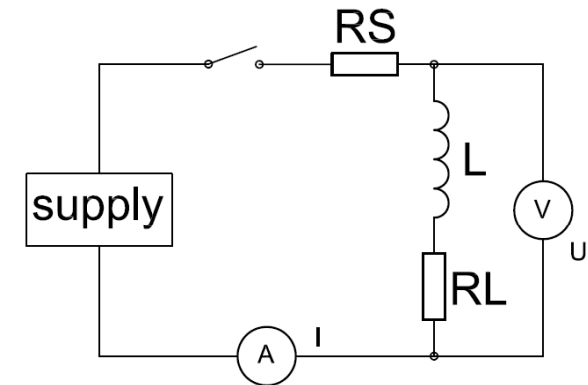
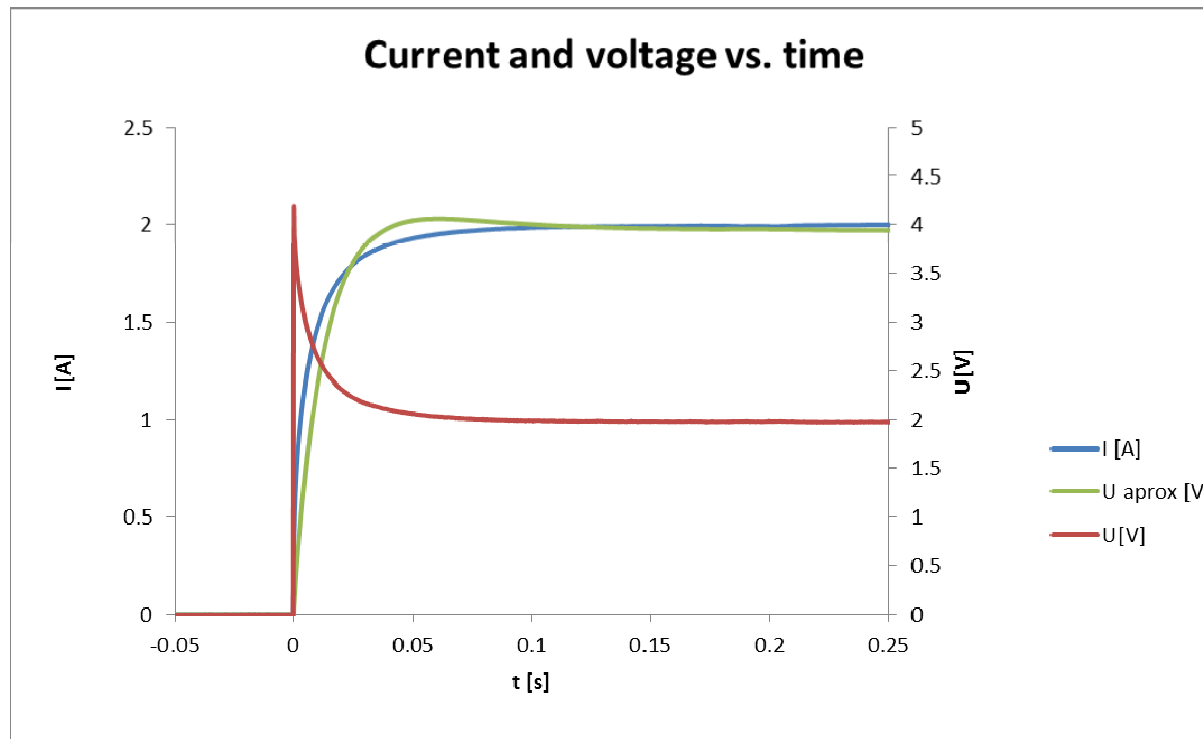


Optimization of control algorithm of MR damper

Measuring stand



Results – time response of the coil's current

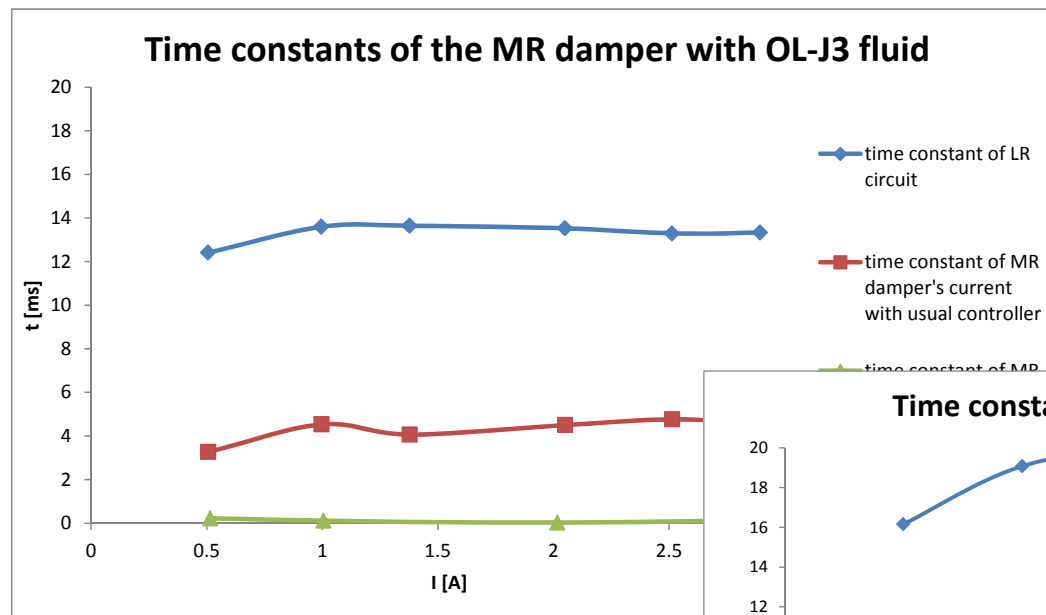


- Supply in voltage mode – from Ohm's law
- Supply in PWM mode – 30 V

$$i = \frac{1}{L} \int u(t) dt, \quad u(t) = i \cdot R_L \Rightarrow i = \frac{U}{R_L} (1 - e^{-\frac{R_L t}{L}})$$

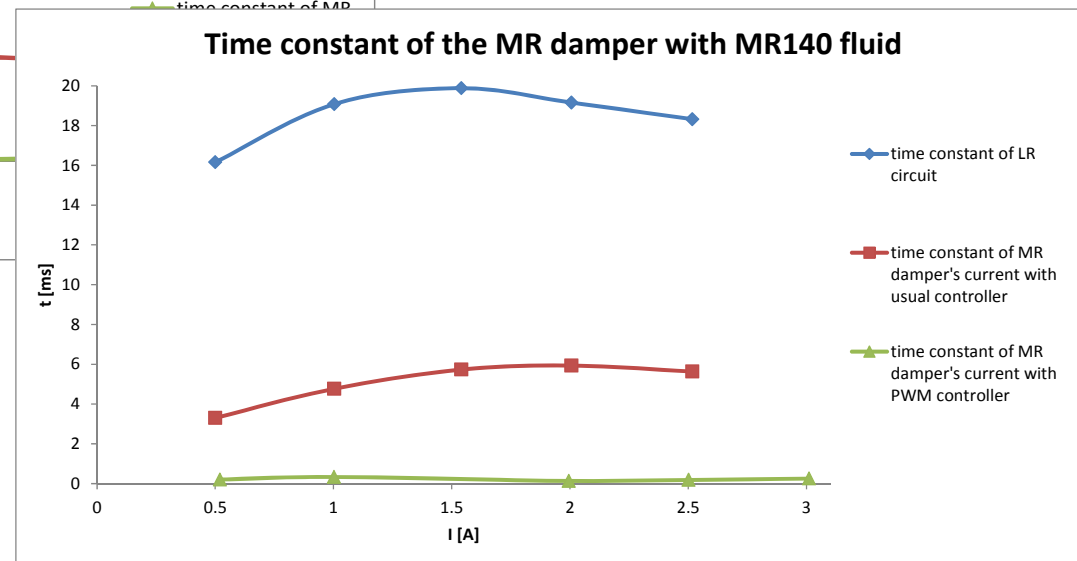
Optimization of control algorithm of MR damper

Results – time response of the coil's current

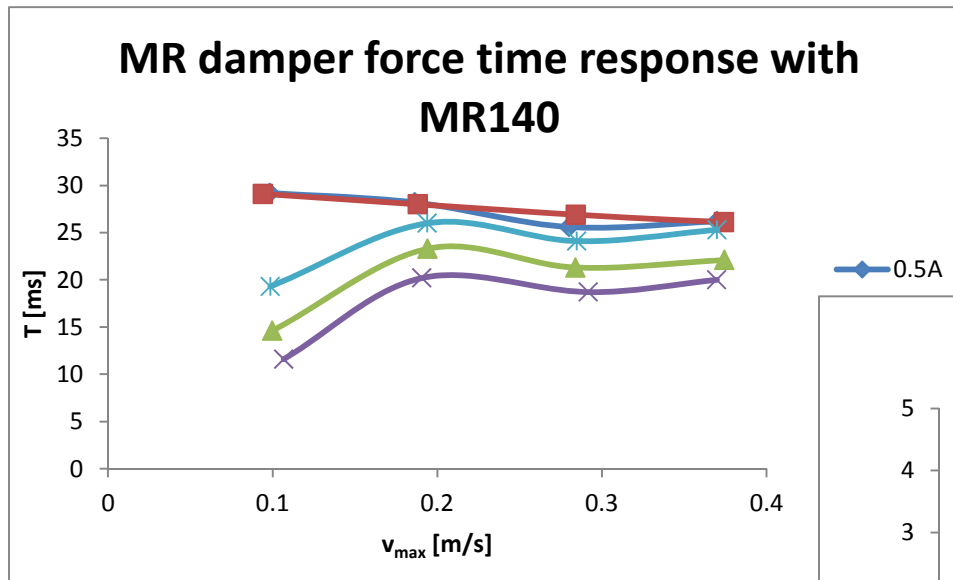


■ The response time of the controller + damper with oil with smaller ratio of Fe particles to base oil is shorter

■ PWM mode significantly reduces time response

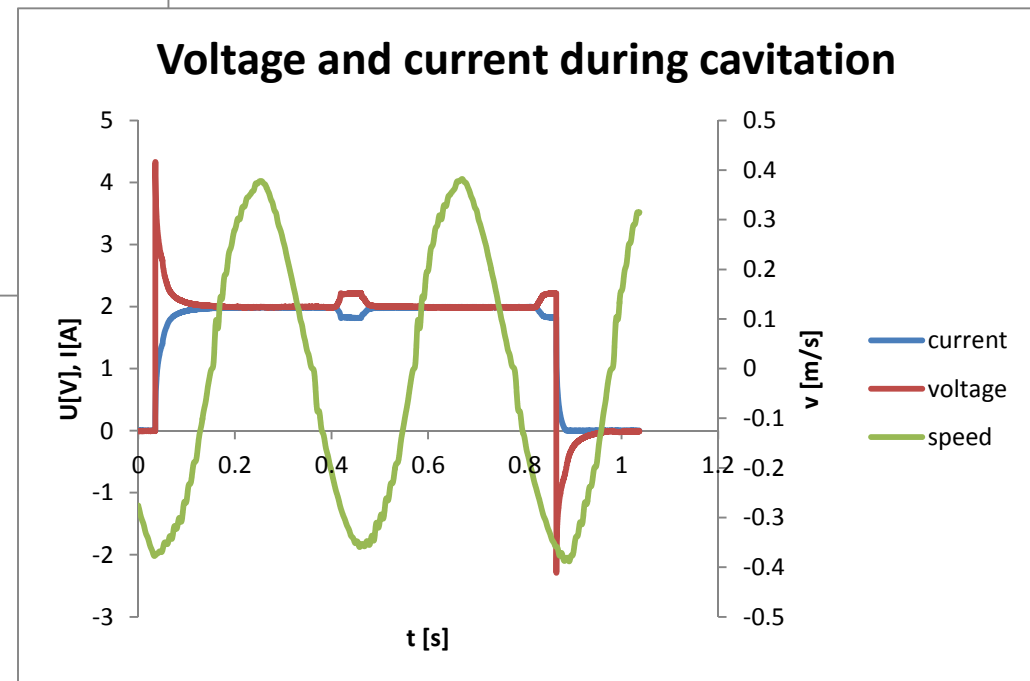


Results – time response of force

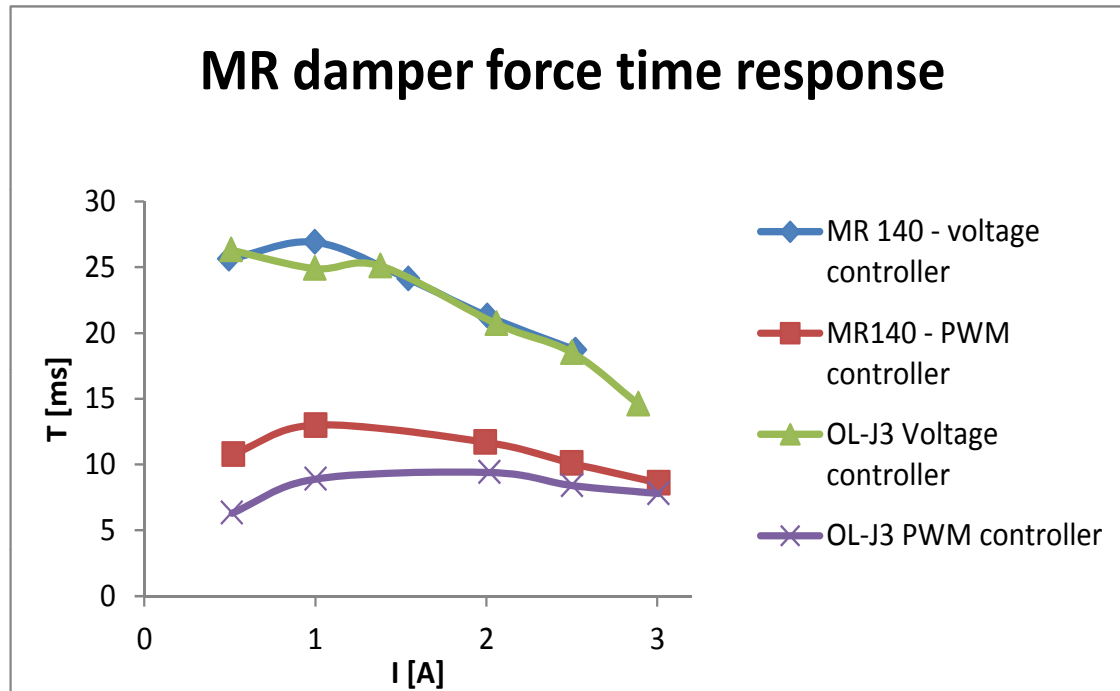


■ The higher the current is, the faster response

■ Possible diagnostics of cavitations



Results – time response of force



- PWM controller significantly reduces overall time response of the MR damper
- The time response of the MR damper is much longer than time response of MR fluid


Plans for future

- Finding of the cause of the long time response
 - Measurement of the magnetization of the coil's core
- The possibility of using current overdrive
- Design of the controller with recuperation (improving efficiency)
- Measurements of the suspension quality of the advanced control algorithms with voltage and PWM controller

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