ACTIVITIES AT IMID 2018-2020

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Brno, 20.5.2020

ÚSTAV
KONSTRUOVÁNÍ

CONTENT

- PhD thesis
- Research activities
- Other activities
- Publication and products
- Teaching

DEPARTMENT OF CONDITION MONITORING

Vibro-acoustics

Brigade commander





Employees


Non-destructive testing

Brigade commander


Employees

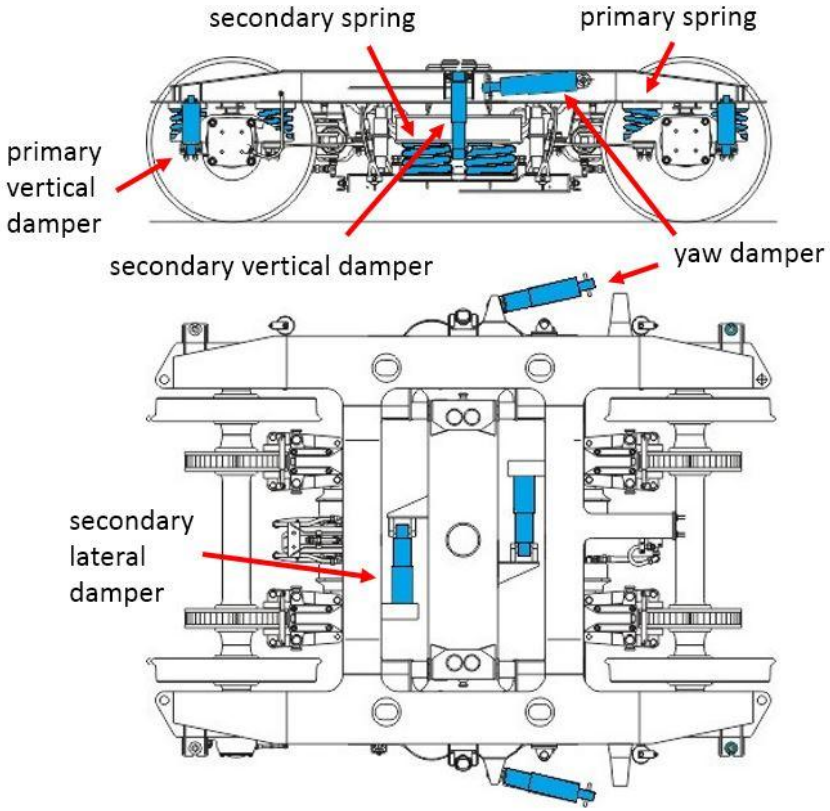

PHD THESIS

Semi-actively damped chassis for high-speed train

doc. Ing. Ivan Mazůrek CSc.

Ing. Zbyněk Strecker PhD.

locomotive Vektron *zdopravy.cz*



Train chassis *st-os.cz*

PHD THESIS

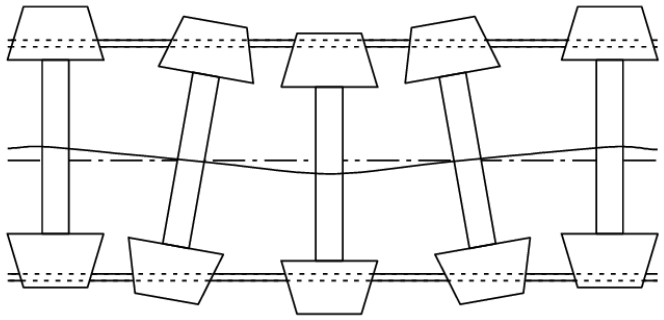
Motivation

- contradiction on yaw damper requirements for different driving modes

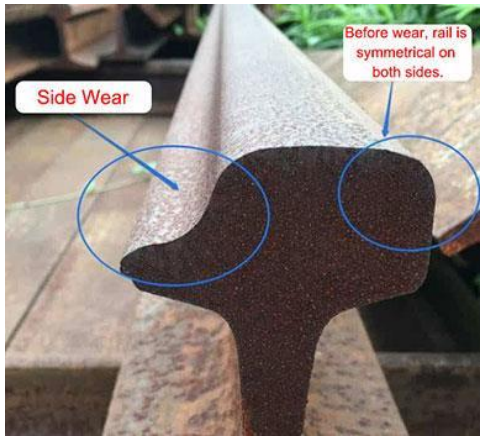
  high speed on straight track (high) x arch passage (low)

- actuators x semi-active dampers (unpublished yet)

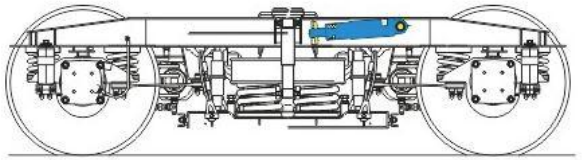
→ increase critical speed and reduce wear

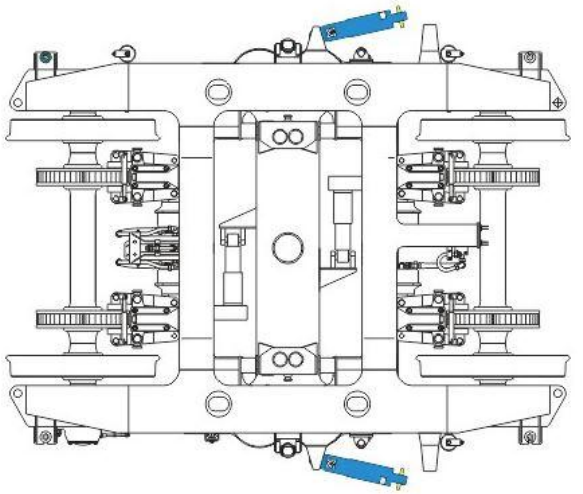


Hunting motion



Rail wear *rail-fastener.com*





Train chassis *st-os.cz*

PHD THESIS

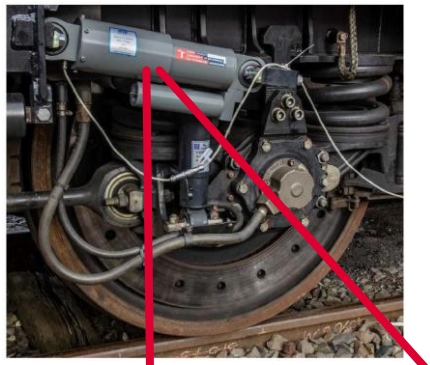
Methods

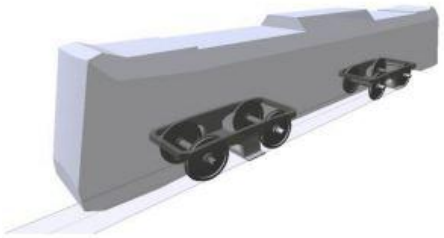
- rail tracking algorithms (groundhook)
- F-v char. and time responce of real damper
- model SJKV – DFJP UP
- RCP – dSpace + Inova

$$b = \begin{cases} b_{max}, & \dot{\varphi}_z < 0 \\ b_{min}, & \dot{\varphi}_z \geq 0 \end{cases}$$

$$b = \begin{cases} b_{max}, & \dot{\varphi}_z \cdot (\varphi_z - \varphi_{trat}) < 0 \\ b_{min}, & \dot{\varphi}_z \cdot (\varphi_z - \varphi_{trat}) \geq 0 \end{cases}$$

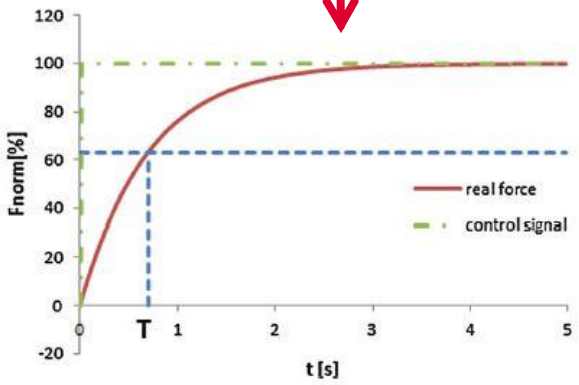
$$b = \begin{cases} b_{max}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z < 0 \\ b_{min}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z \geq 0 \end{cases}$$



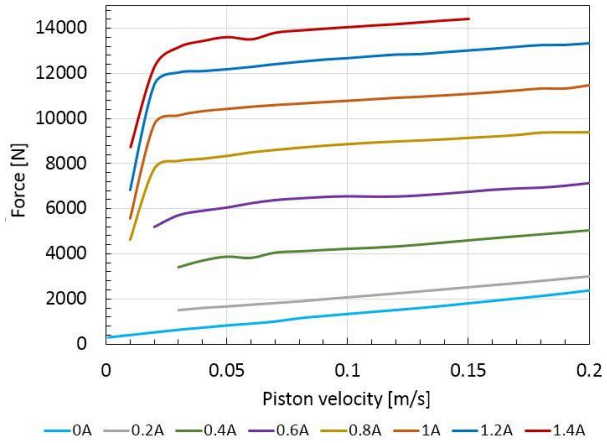


SJVK *Zelenka, 2014*

INOVA pulzator
www.ustavkonstruovani.cz



Časová odezva, *Strecker, 2015*



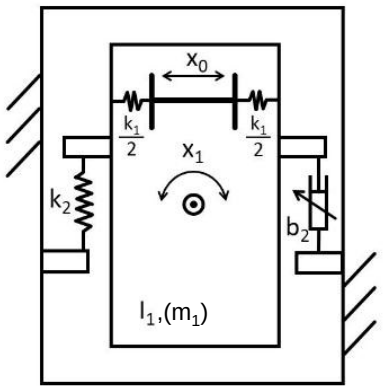
PHD THESIS

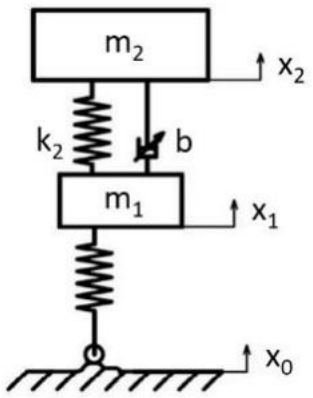
Current results

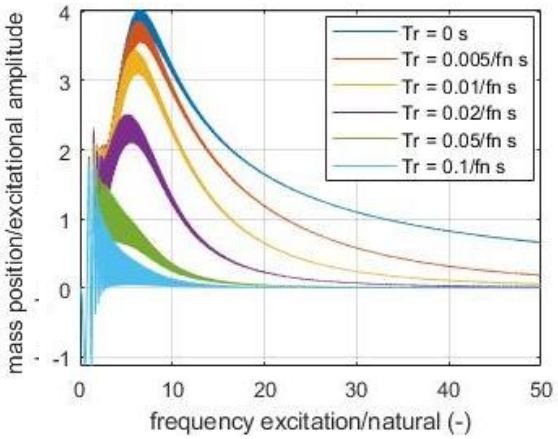
- sprung mass possitioning by semi-actively controled damper, arch passage
- simple 2DOF and 1DOF model
- necessary structural modification to achieve better results

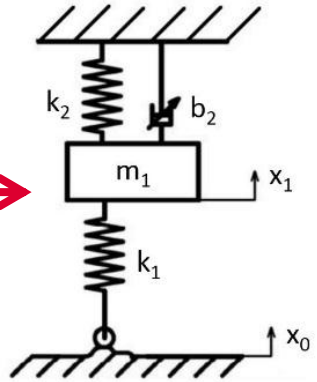
$$F_b = \begin{cases} b_{max}(\dot{x_1} - \dot{x_2}), & (\dot{x_1} - \dot{x_2}) \geq 0 \\ b_{min}(\dot{x_1} - \dot{x_2}), & (\dot{x_1} - \dot{x_2}) < 0 \end{cases}$$

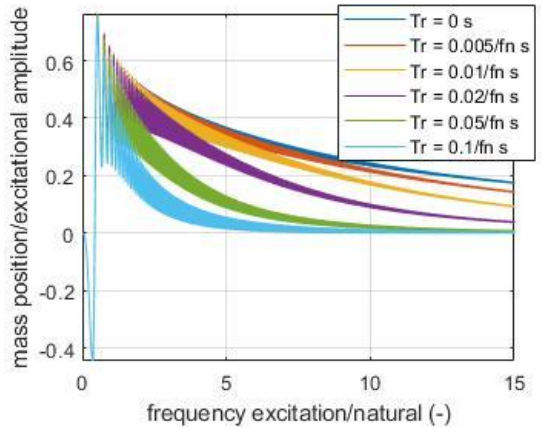
$$F_b = \begin{cases} b_{2max}(\dot{x_1}), & \dot{x_1} < 0 \\ b_{2min}(\dot{x_1}), & \dot{x_1} \geq 0 \end{cases}$$











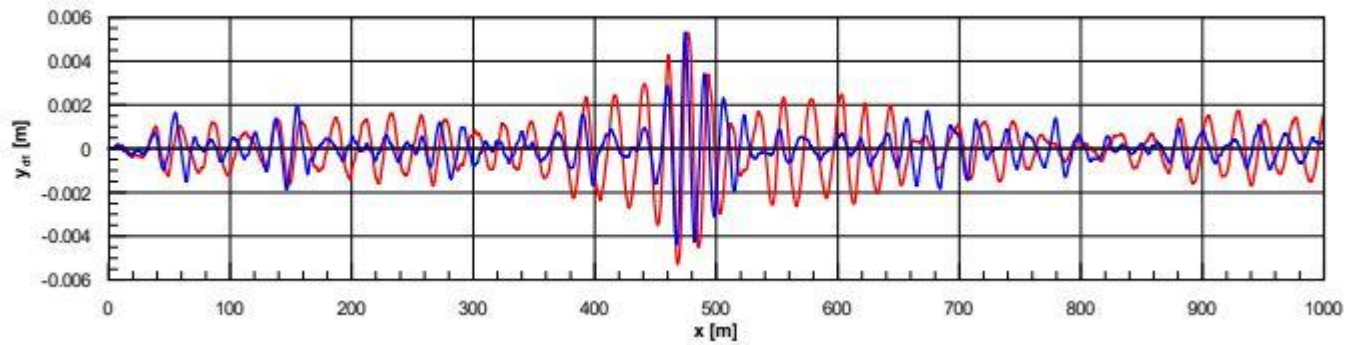
PHD THESIS

Current results

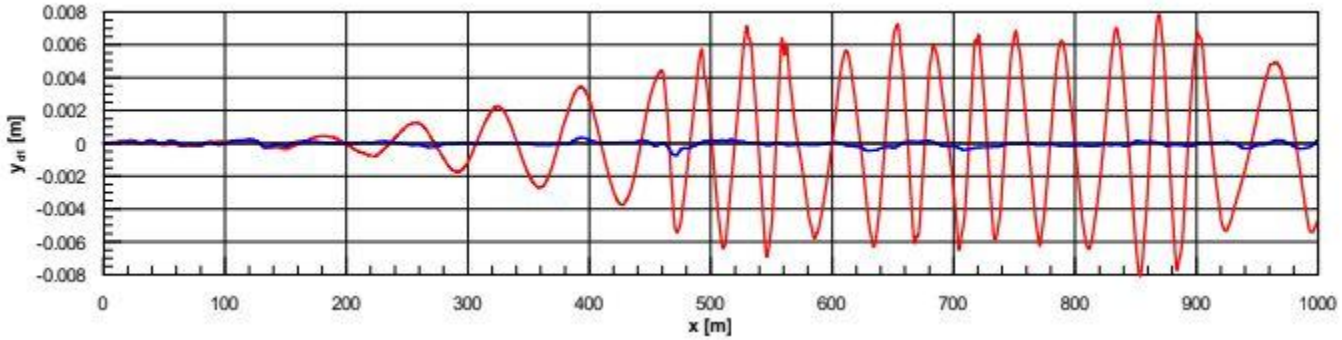
- straight track, 220 km/h
- SJKV
- wheelset lateral displacement
- equivalent conicity 0,4 and 0,01

$$b = \begin{cases} b_{max}, & \dot{\varphi}_z \cdot (\varphi_z - \varphi_{trať}) < 0 \\ b_{min}, & \dot{\varphi}_z \cdot (\varphi_z - \varphi_{trať}) \geq 0 \end{cases}$$

$$b = \begin{cases} b_{max}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z < 0 \\ b_{min}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z \geq 0 \end{cases}$$



First wheelset lateral displacement, equivalent conicity – 0,4

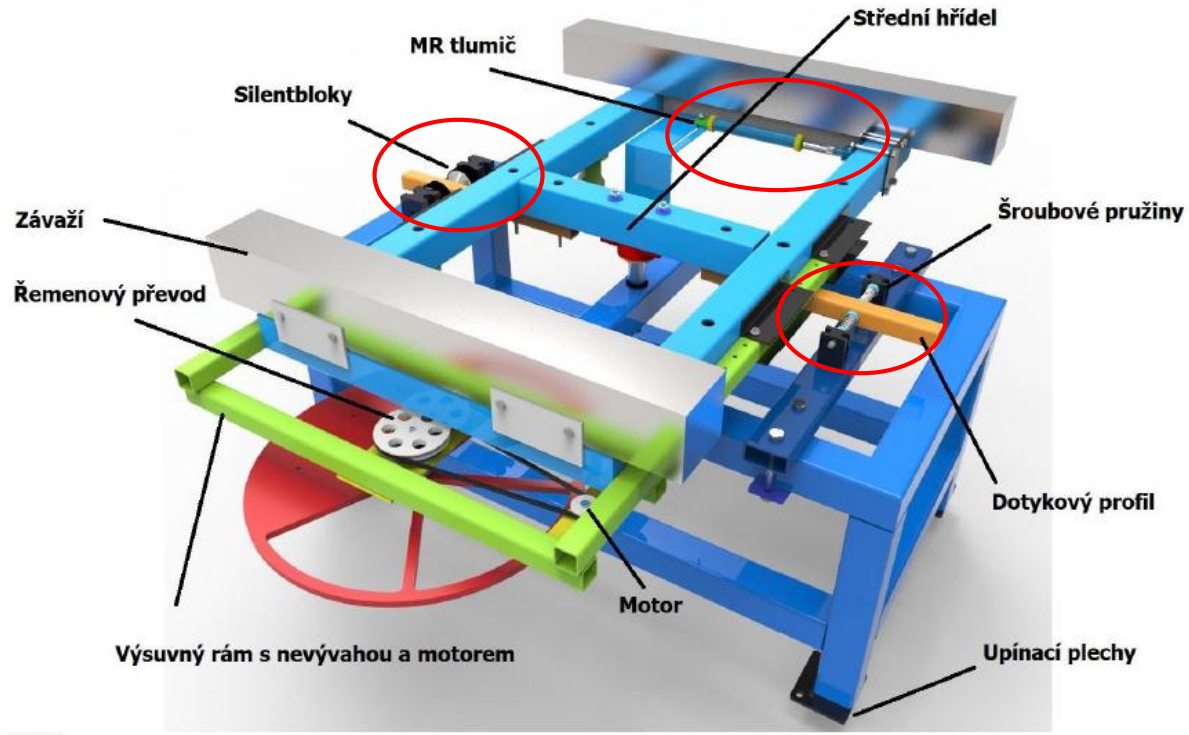


First wheelset lateral displacement, equivalent conicity – 0,01

PHD THESIS

Next steps

- force excitation – 1DOF arch passage
- arch passage – SJKV
- decrease time responce
- various F-v characteristics
- $b = \begin{cases} b_{max}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z < 0 \\ b_{min}, & \dot{\varphi}_z \cdot \ddot{\varphi}_z \geq 0 \end{cases}$
- RCP verification
- demonstration of the proposed solution on a railway bogie physical scale model

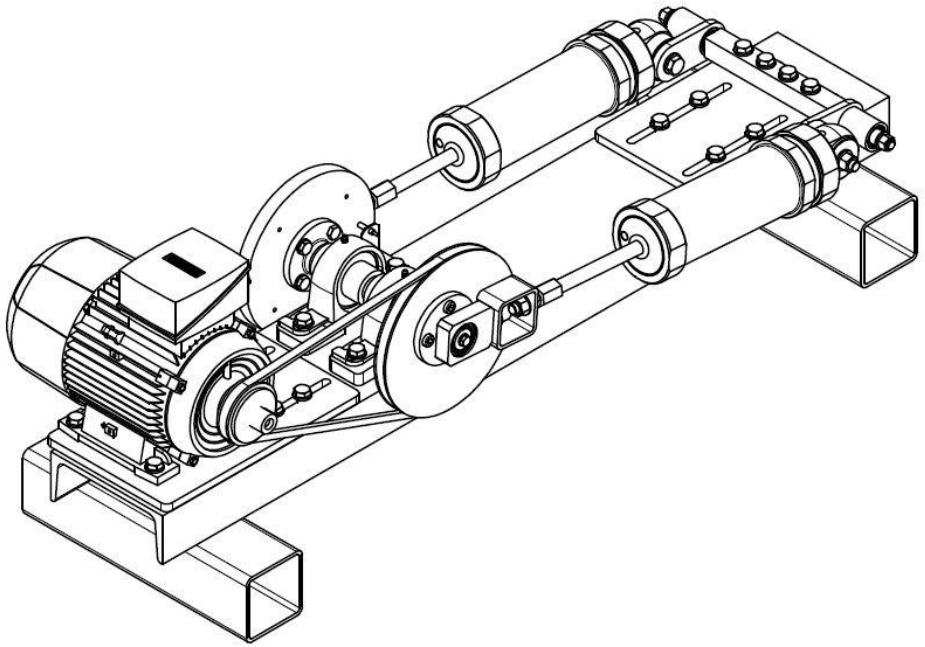


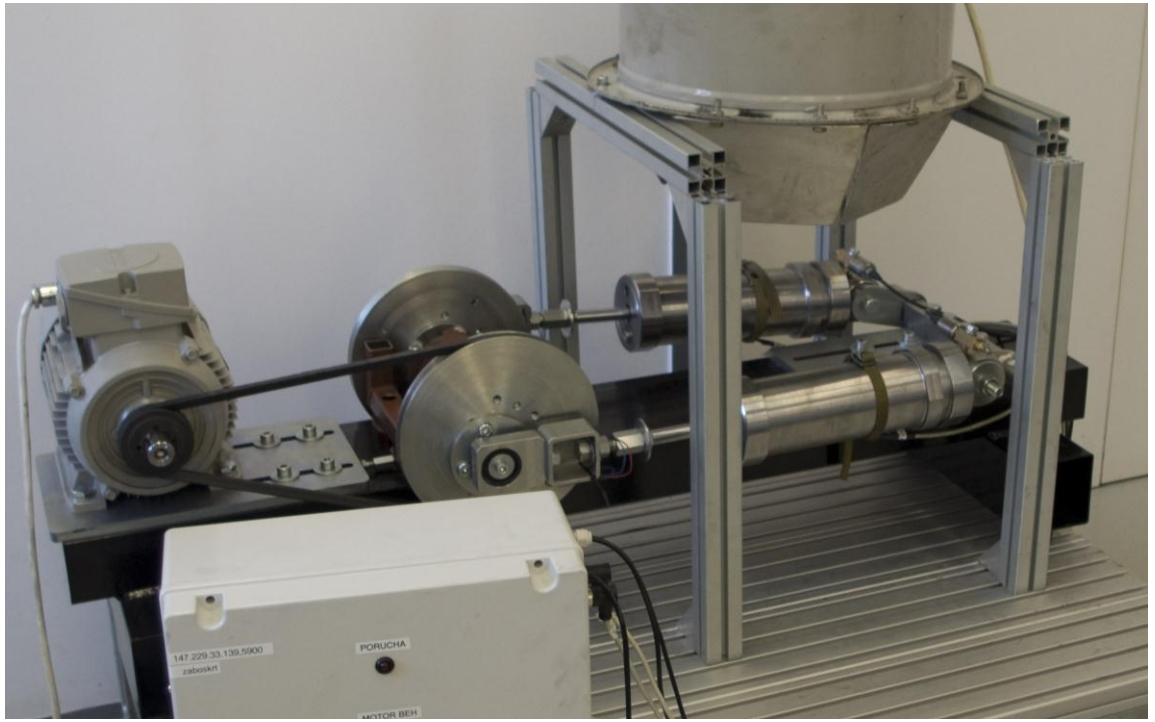
Hunting motion demonstrator

RESEARCH ACTIVITIES

MPO – Developement of Magnetorheological Damping System for Railway Vehicles

- seal tester

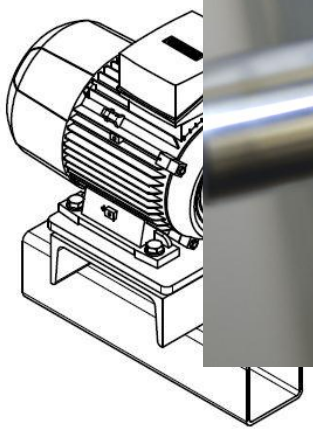


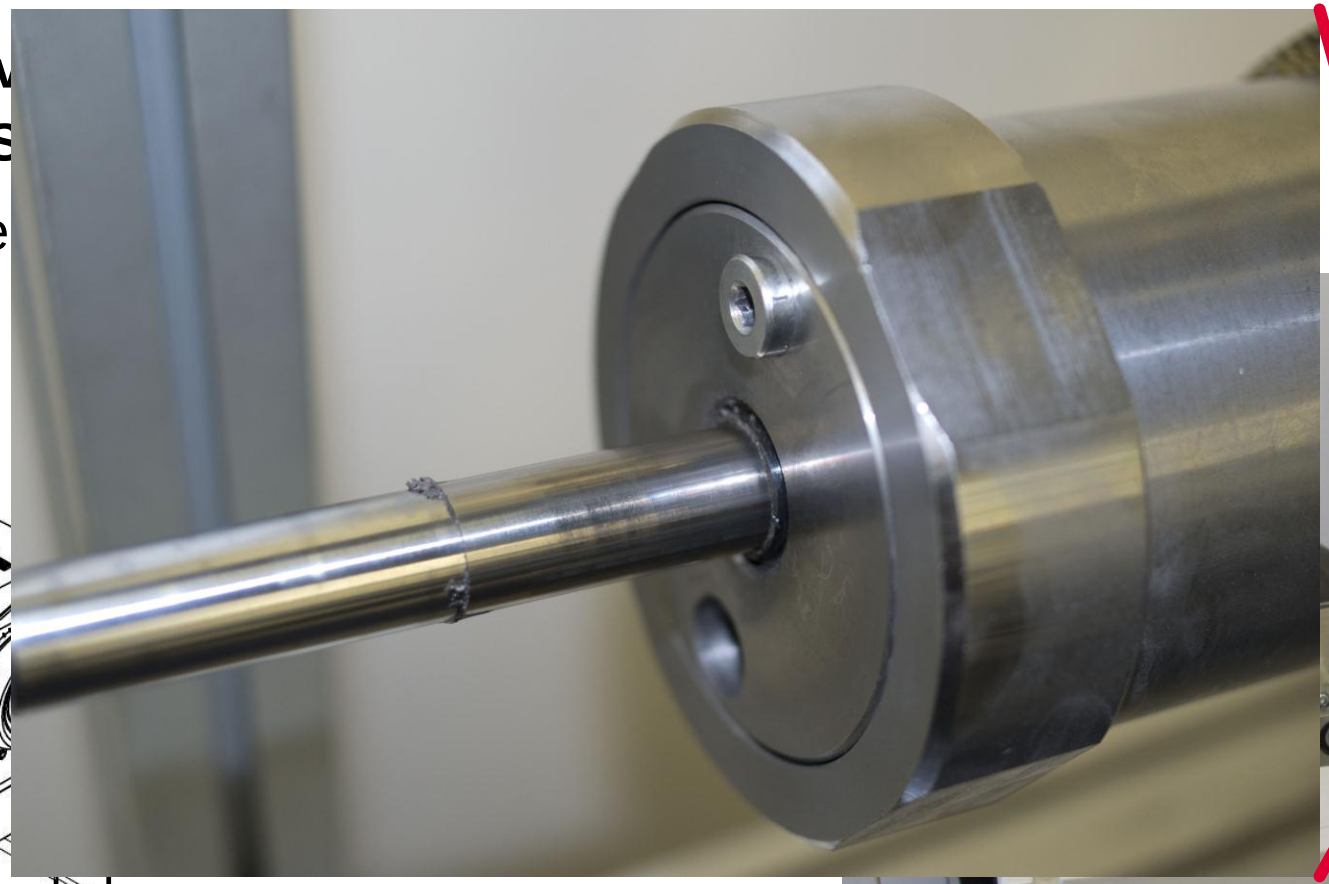


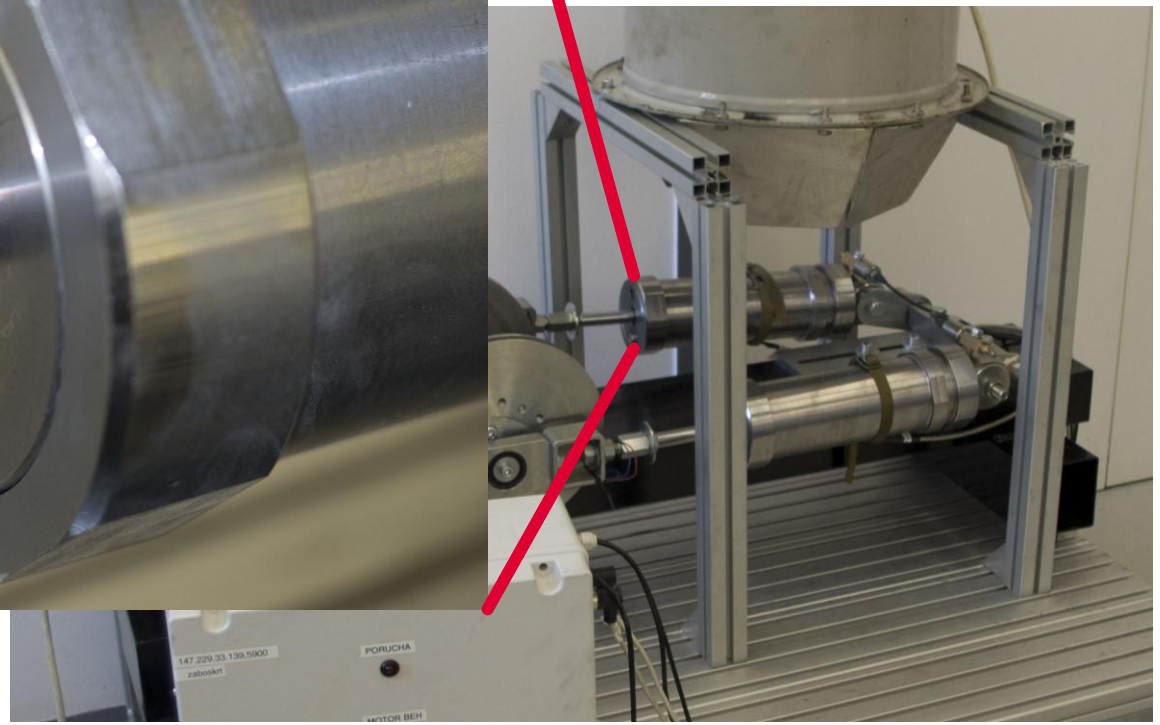
RESEARCH ACTIVITIES

MPO – Dev
Damping S

- seal teste



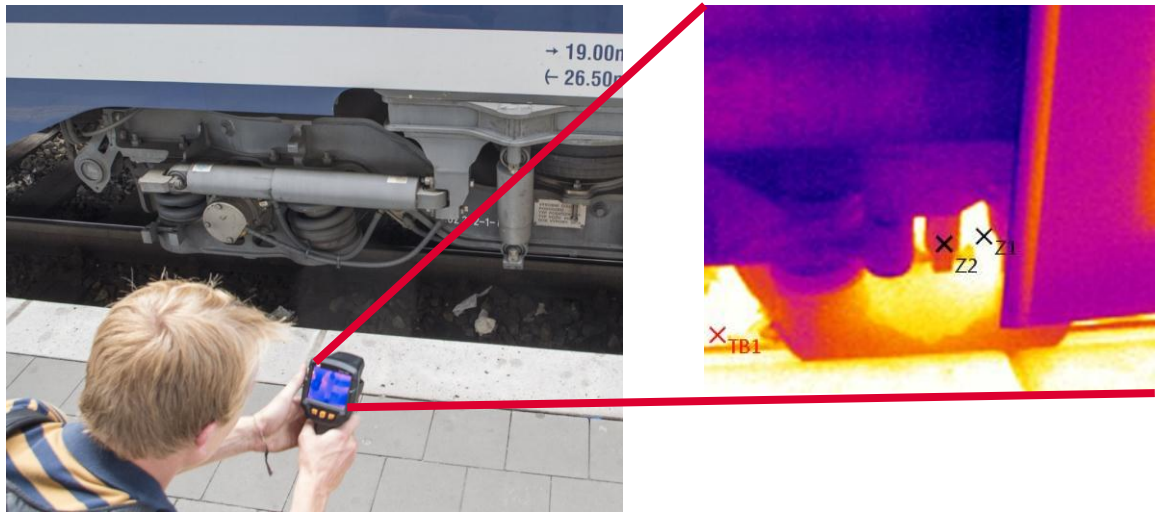


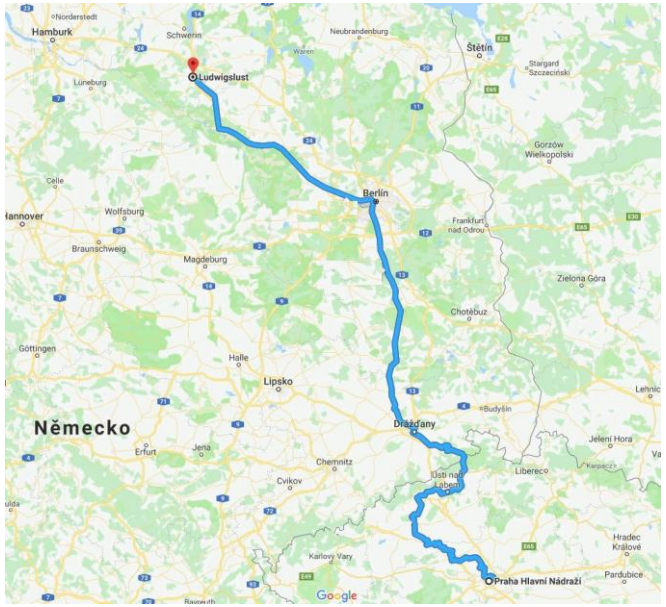


RESEARCH ACTIVITIES

MPO – Developement of Magnetorheological Damping System for Railway Vehicles

- measurement of operating conditions on a high-speed rail – damper temperature



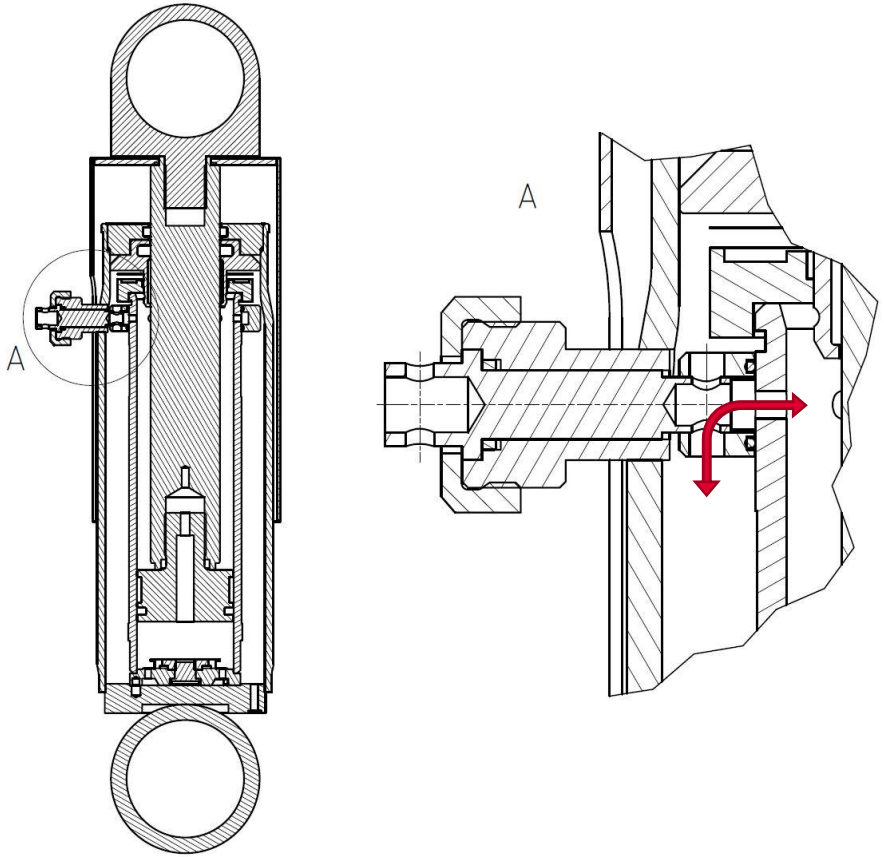


čas měření	místo	strana	vůz	P80 L (°C)	P8 (°C)	P80 P (°C)	okolí (°C)
8:40	Praha	pravá	1	23	24	26	23
9:50	Ústí nad Labem	pravá	1	30	28		26
10:20	Děčín	levá	1	32	33		26
11:20	Bad Schandau	pravá	2	27	26	26	23
11:55	Dresden	levá	2	26	24	27	23
13:35	Berlin Süd.	levá	2	30	26	30	20
13:40	Berlin HBF	levá	2	30	28	32	21
14:30	Wittenberge	levá	2	35	36	37	30
14:50	Ludwigslust	pravá	2		30		22
15:40	Ludwigslust	pravá	3		30		22
16:55	Berlin	levá	3	31	28	32	22

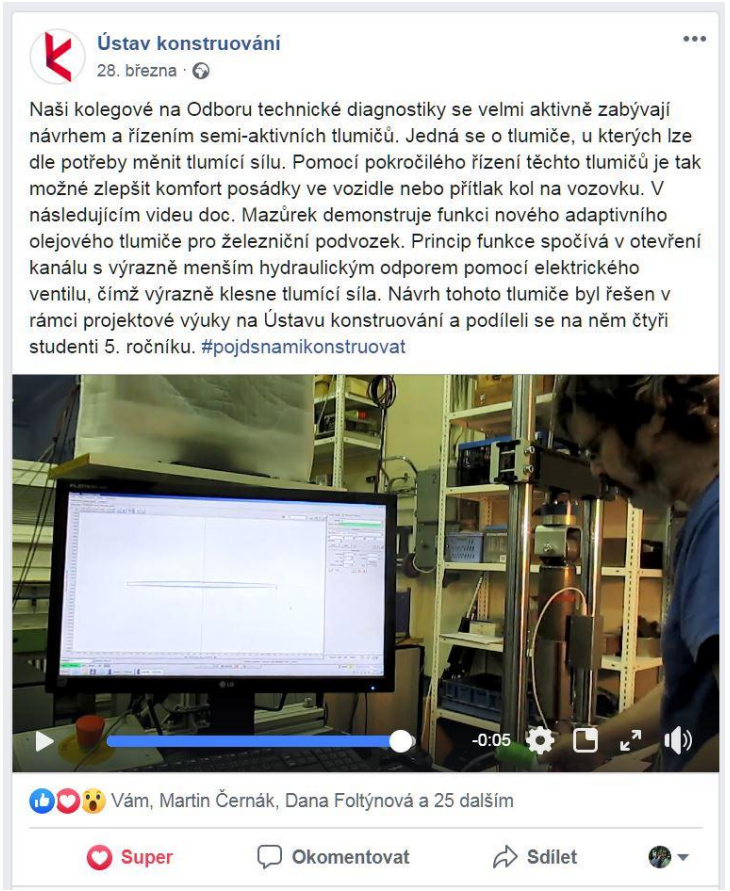
RESEARCH ACTIVITIES

Oil adaptive damper

- without MR fluid
- based on R110 (STOS)
- bypass between inner and outer space



Schema of oil adaptive damper

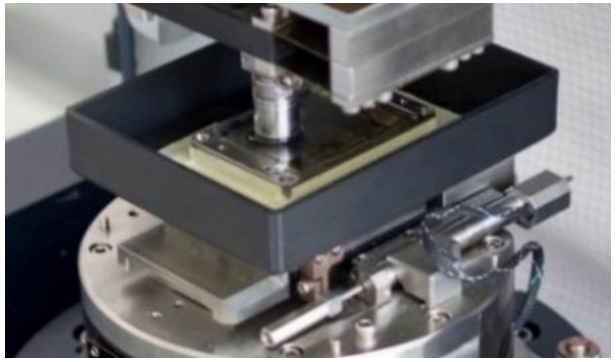


Adaptive damper on ÚK facebook

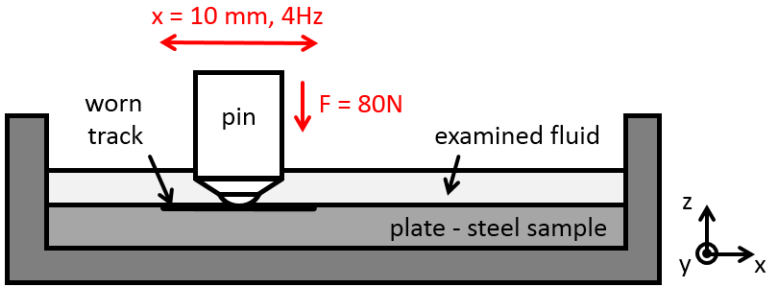
RESEARCH ACTIVITIES

GAČR – Studies on Magnetorheological Fluid with High Sedimentation Stability

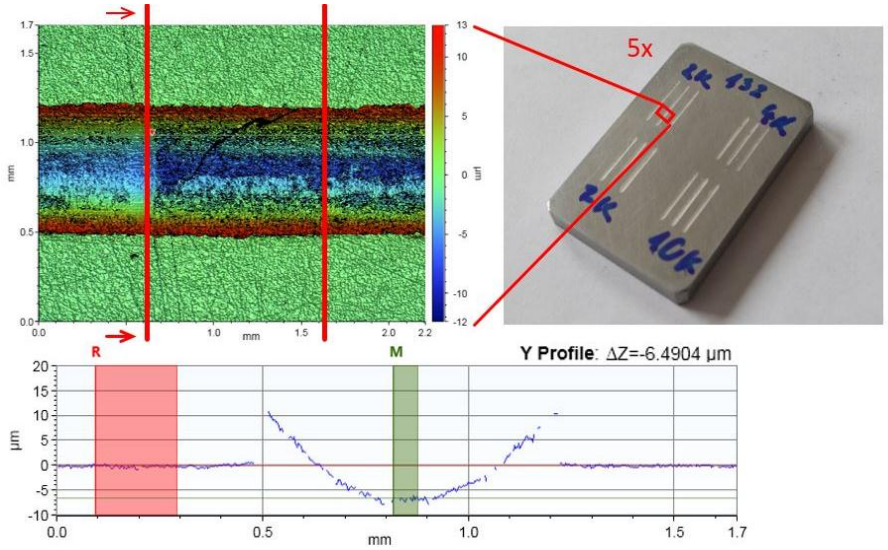
- wear
- comercial MR fluids comparison
- small differences between MR fluids
- twice as large as hydraulic oil



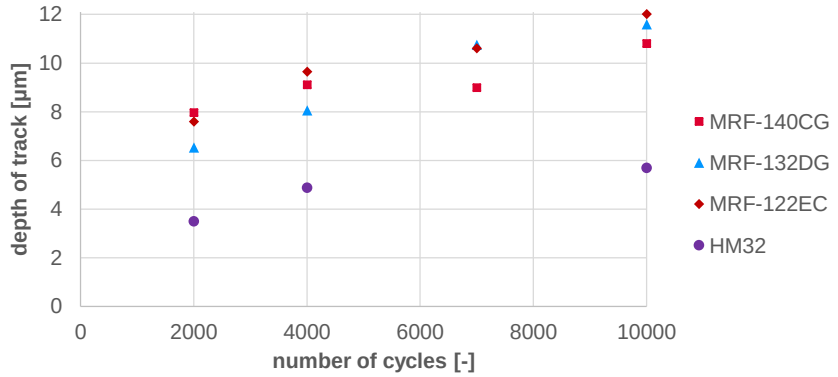
Reciprocating test module



Test scheme



Method of evaluation

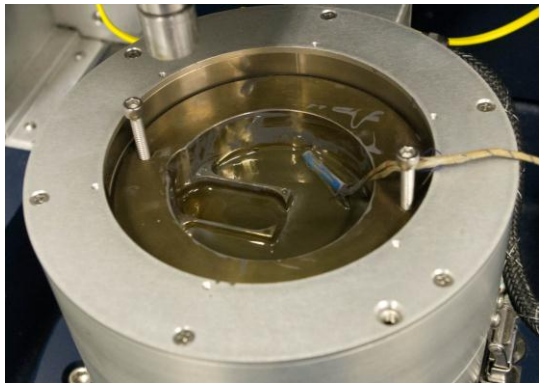


Comparison of all studied fluid

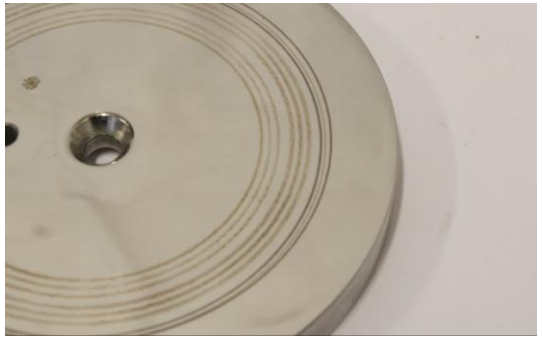
RESEARCH ACTIVITIES

GAČR – Studies on Magnetorheological Fluid with High Sedimentation Stability

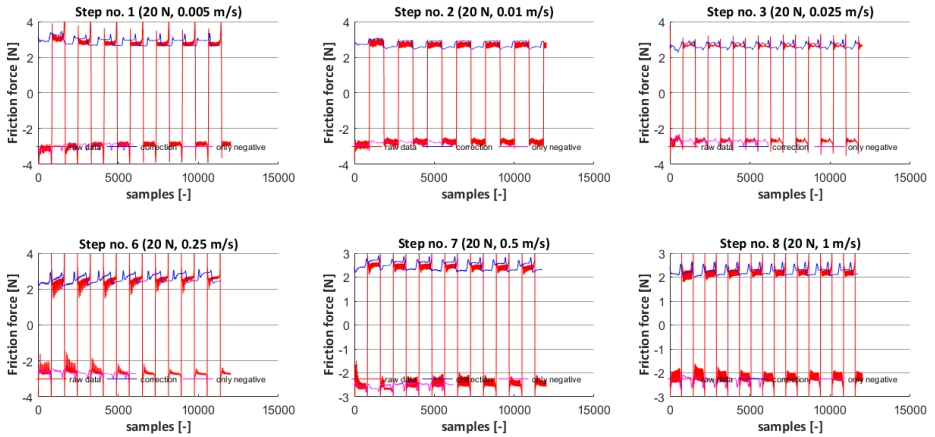
- striebeck curve
- 1-20 N
- 5-4000 mm/s
- high friction of MRF in fluid mode



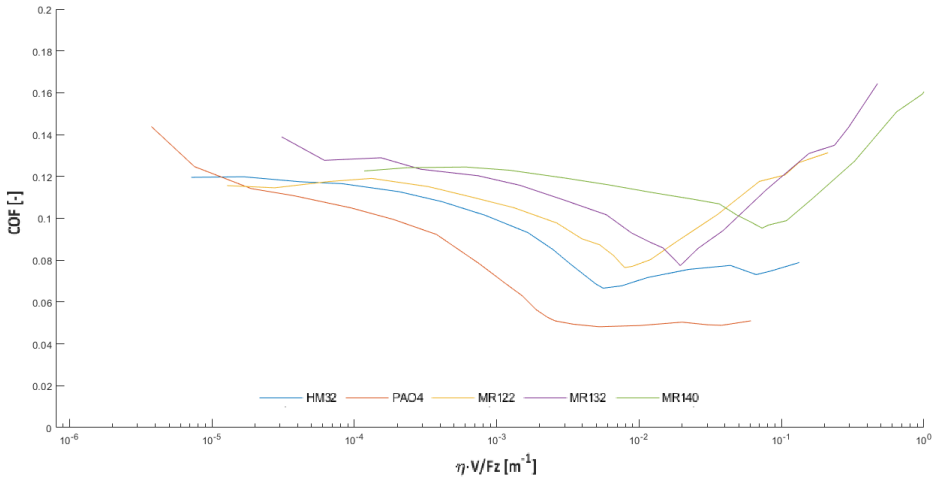
Pin on disk test module



Disk



Detail of selected steps after evaluation



Striebeck curve comparison of all studied fluid

RESEARCH ACTIVITIES

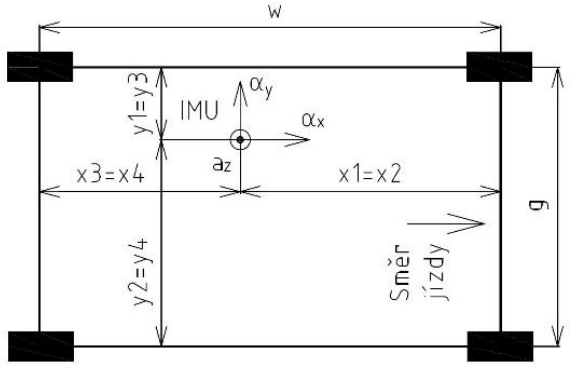
TAČR Epsilon – Electronic car suspension tester

- a new method for on-board suspension testing
- vehicle crosses obstacle,

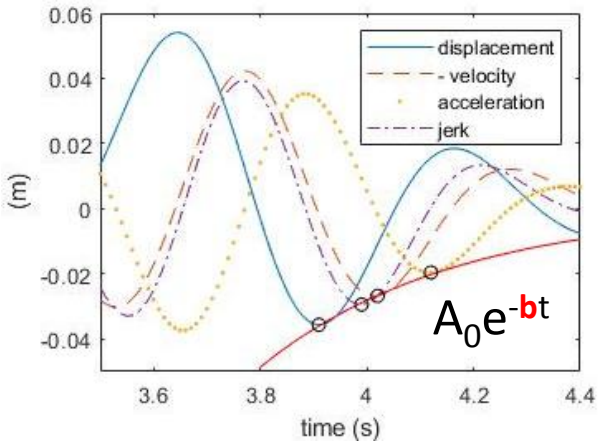
  l = 0,43 m; H = 0,08 m
- IMU
- relative attenuation for each suspension
- standardized differentiation method

Car and obstacle during the on board test

IMU location in the vehicle



The IMU location schema

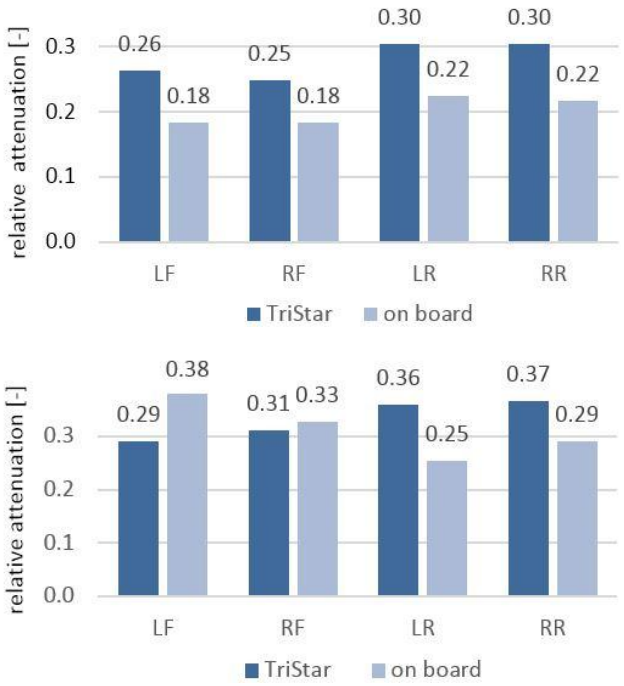


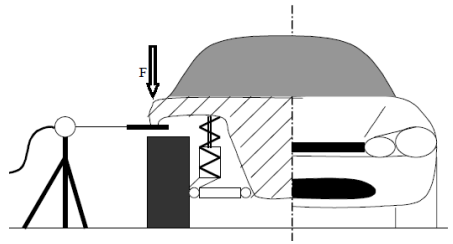
Standardized derivation

RESEARCH ACTIVITIES

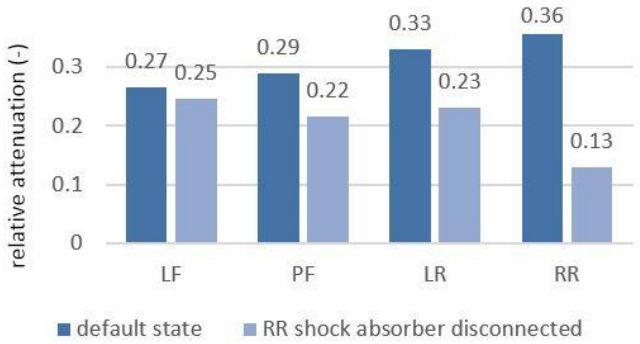
TAČR Epsilon – Electronic car suspension tester

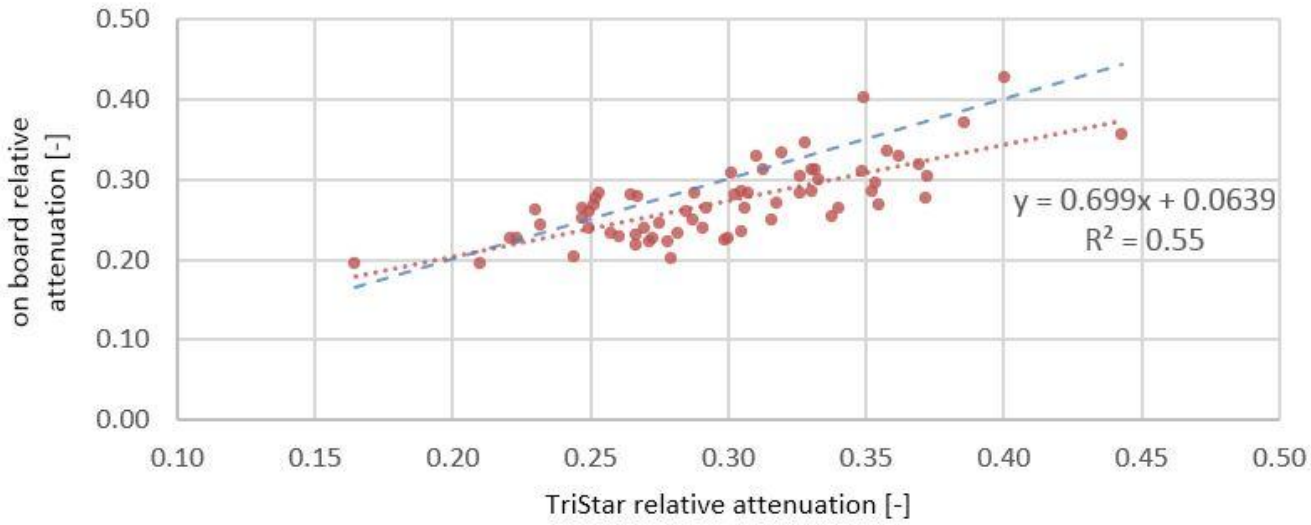
- 65 vehicles





TriStar shock tester measurement

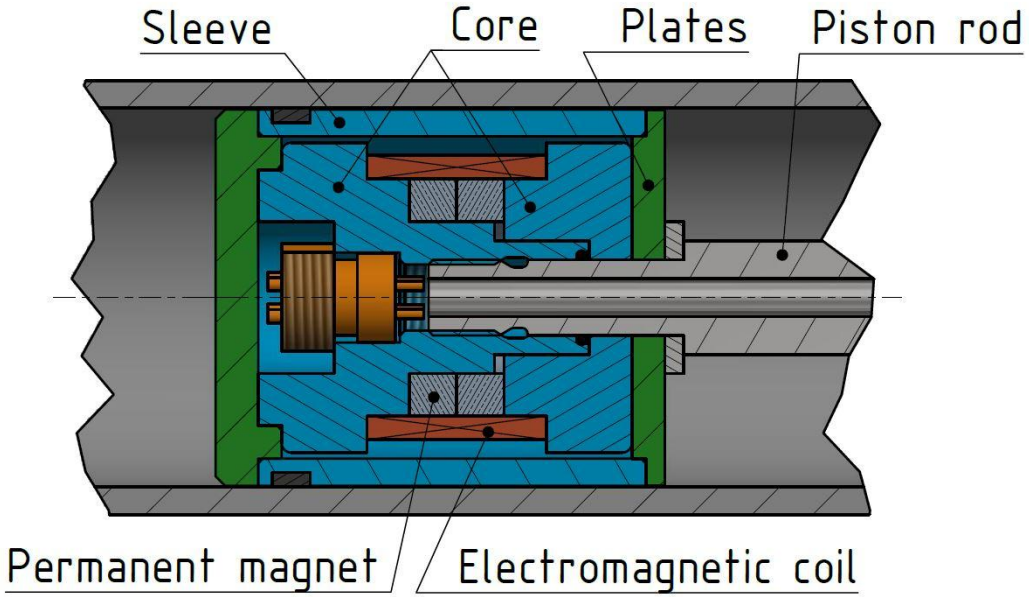




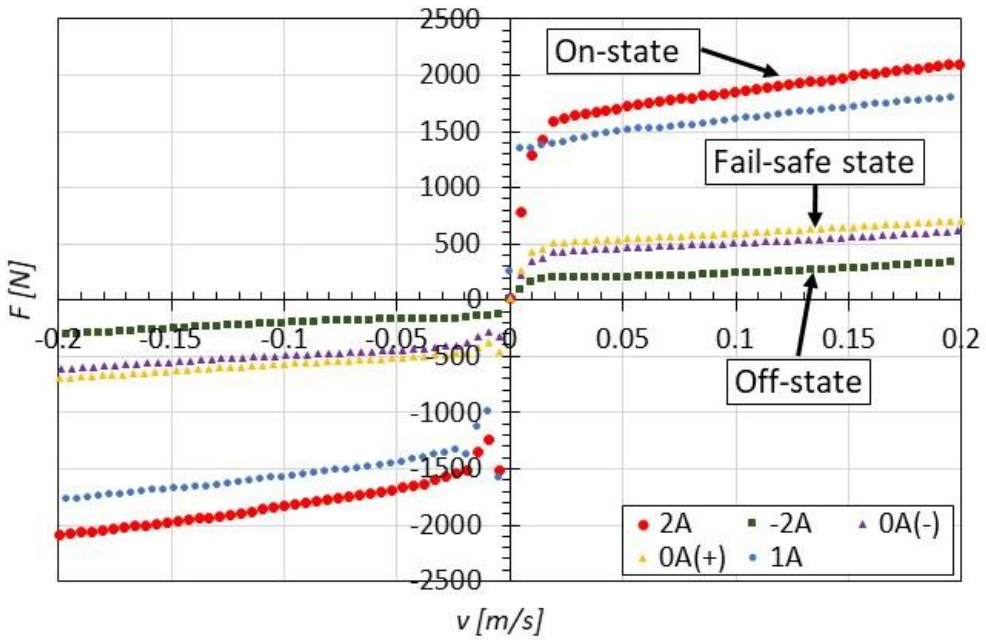
RESEARCH ACTIVITIES

SV 2020 – Failsafe MR damper

- pemanent magnet



Schema of failsafe MR damper



F-v characteristics of failsafe MR damper

RESEARCH ACTIVITIES

FV 2020 – Semi-actively controled damper in HIL simulation

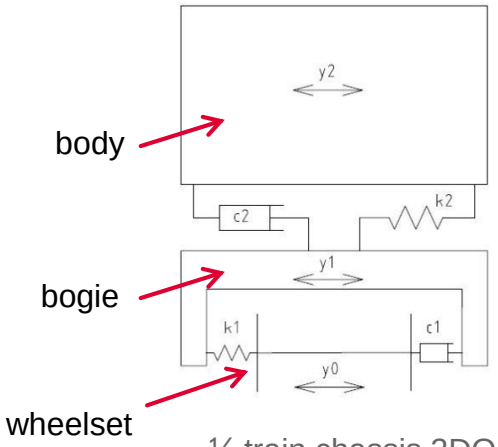
- lateral oscilation of train body
- RCP, dSpace + Inova
- 33 % vibration reduction
- 2.5x higher damper force

$$c_2 = \begin{cases} c_{2max} & \text{if } \dot{y}_2 \cdot (\dot{y}_2 - \dot{y}_1) > 0 \\ c_{2min} & \text{if } \dot{y}_2 \cdot (\dot{y}_2 - \dot{y}_1) \le 0 \end{cases}$$

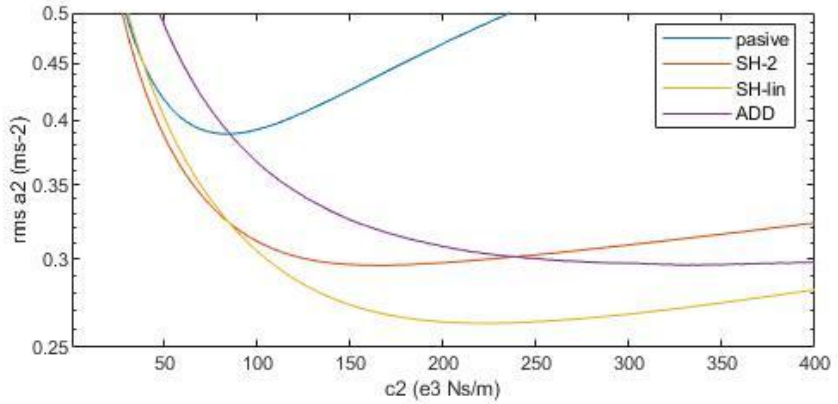
SH-2

$$c_2 = \begin{cases} sat\left(\dfrac{\alpha \cdot c_{2max} \cdot (\dot{y}_2 - \dot{y}_1) + (1-\alpha) \cdot c_{2max} \cdot \dot{y}_2}{(\dot{y}_2 - \dot{y}_1)}\right) & \text{if } \dot{y}_2 \cdot (\dot{y}_2 - \dot{y}_1) > 0 \\ c_{min} & \text{if } \dot{y}_2 \cdot (\dot{y}_2 - \dot{y}_1) \le 0 \end{cases}$$

SH-lin



¼ train chassis 2DOF model



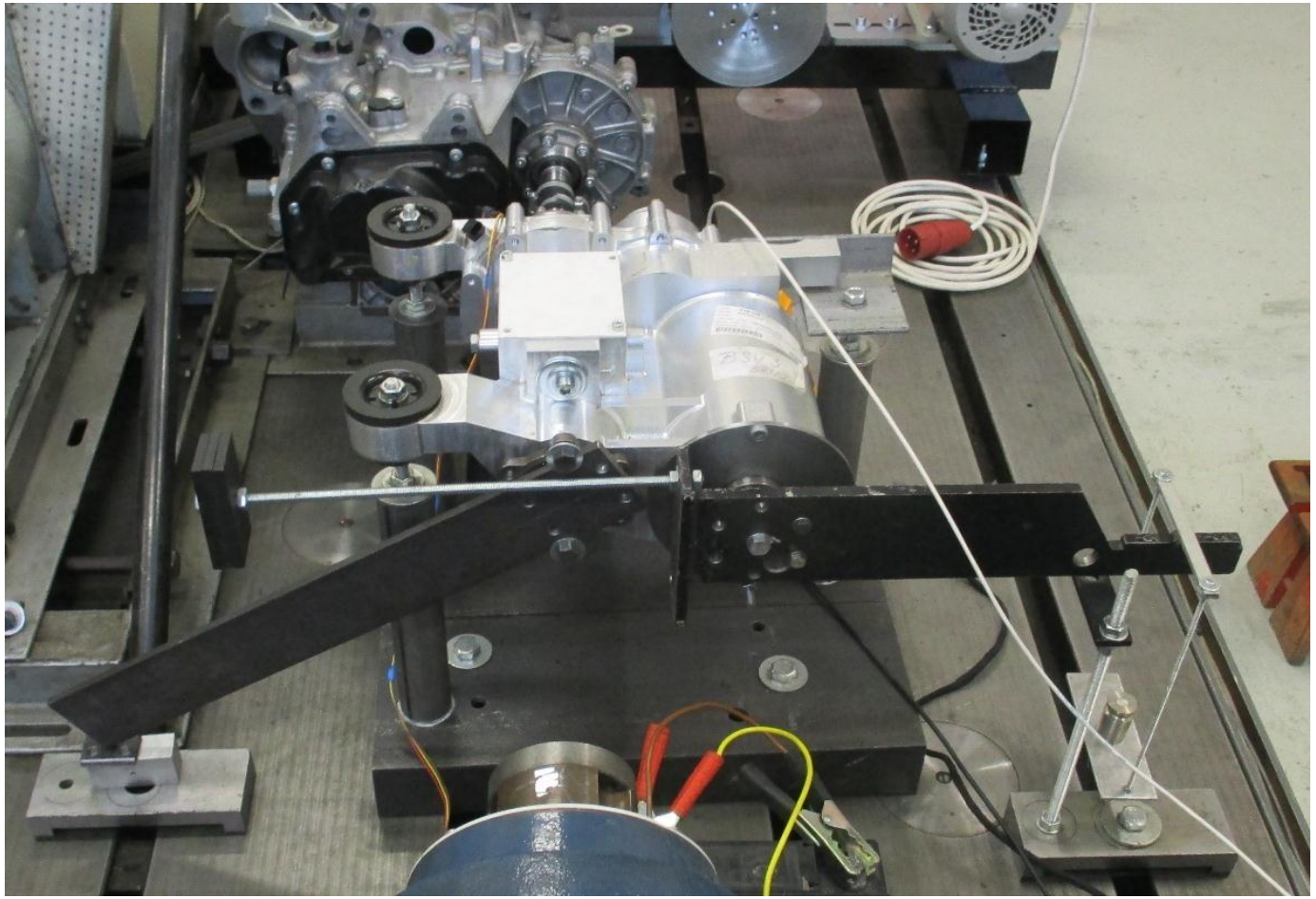
body acceleration RMS dependence on damper coeficient (active state)

Pulzátor INOVA
www.ustavkonstruovani.cz

OTHER ACTIVITIES

HS – Škoda Auto

- new gearbox for hybrid car
- gear engage and disengage tests
- DC motor x electromagnet

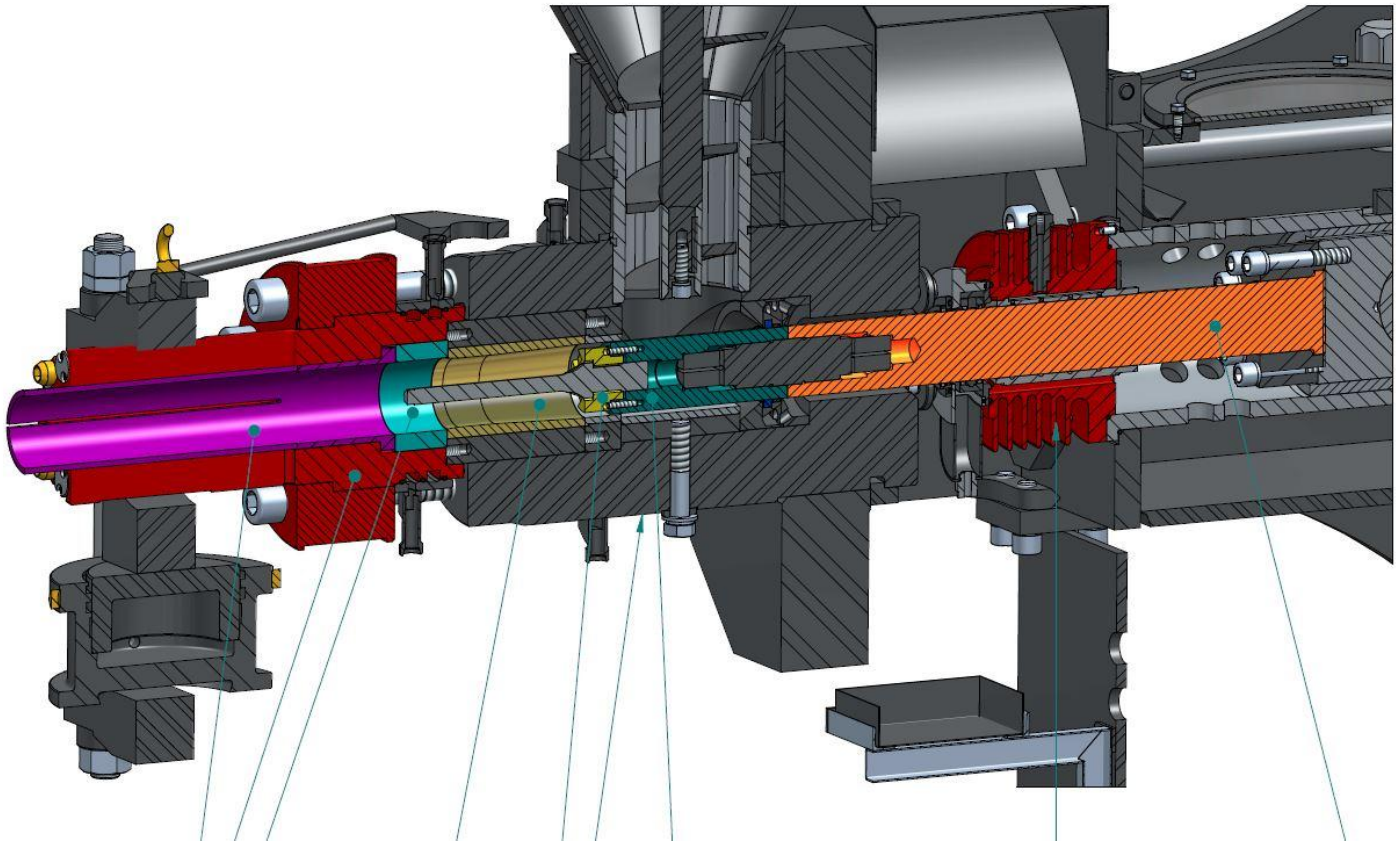


Škoda gearbox on test stand

OTHER ACTIVITIES

Briquete machine

- prof. Píštěk
- structural calculation of some parts



Schema on briquete machine

OTHER ACTIVITIES

NAWA - EMMAT

- International Workshop for EMMAT consortium partners in Brno

OTHER ACTIVITIES

Pneumobile

- 0ZP(3x), ZIP(1x), ZKP(1x), BP (1x)
- promotional events, operability
- cooperation with Bc. students

Pneumobile team

PhDr. Ivan Bartoš PhD. in pneumobile

Pneumobile in VW Caravelle

PUBLICATION AND PRODUCTS

- JENIŠ, F.; ROUPEC, J.; ŽÁČEK, J.; KUBÍK, M.; MACHÁČEK, O.; SMILEK, J.; SMILKOVÁ, M.; MAZŮREK, I. *Abrasion of Magnetorheological Fluids.* In Engineering Mechanics 2019, 25th International Conference. Praha: Institute of Thermomechanics of the Czech Academy of Sciences, 2019. s. 169-172. ISBN: 978-80-87012-71-0. **(Svratka)**
- KUBÍK, M.; ROUPEC, J.; JENIŠ, F.; MAZŮREK, I. *The settings of CFD model with magnetorheological fluid and its influence on the results*. In Engineering Mechanics 2019, 25th International Conference. Praha: Institute of Thermomechanics of the Czech Academy of Sciences, 2019. s. 223-226. ISBN: 978-80-87012-71-0. **(Svratka)**
- JENIS, F.; MAZUREK, I. *Mechatronicaly controlled bogie of high speed train.* CONFERENCE PROCEEDINGS 60th International Conference of Machine Design Departments. Brno Universtiy of Technology, 2019. **(ICMD)**
- JENIS, F.; STRECKER, Z.; MAZUREK, I. *A new method for on-board car suspension testing.* **(Svratka – send)**
- JENIS, F.; MAZUREK, I. *Sprung mass positioning by semi-actively controlled damper.* **(MATBUD Krakow – send)**

- JENIŠ, F.; MAZŮREK, I.: Overcross 7D; *Simulační model dynamické struktury podvozku vozidla při přejezdovém testu*. místnost B1/111 ÚSTAV KONSTRUOVÁNÍ Fakulta strojního inženýrství Vysoké učení technické v Brně Technická 2896/2. URL: http://pom.uk.fme.vutbr.cz/pdf_projekt.php?id=372. **(software)**
- MAZŮREK, I.; JENIŠ, F.; SKUHRAVÝ, P.: Prah; *Univerzální přejezdová překážka*. místnost B1/111 ÚSTAV KONSTRUOVÁNÍ Fakulta strojního inženýrství Vysoké učení technické v Brně Technická 2896/2. URL: http://pom.uk.fme.vutbr.cz/pdf_projekt.php?id=376. **(funkční vzorek)**
- MAZŮREK, I.; JENIŠ, F.; SKUHRAVÝ, P.: RBox; *Inerciální jednotka pro snímání pohybu karoserie*. místnost B1/111 ÚSTAV KONSTRUOVÁNÍ Fakulta strojního inženýrství Vysoké učení technické v Brně Technická 2896/2. URL: http://intranet.ustavkonstruovani.cz/file-download/get-project-pdf/392. **(funkční vzorek)**
- JENIŠ, F.; MAZŮREK, I.; SKUHRAVÝ, P.: ControlBox; *Řídící a analytický program přejezdového testeru*. místnost B1/111 ÚSTAV KONSTRUOVÁNÍ Fakulta strojního inženýrství Vysoké učení technické v Brně Technická 2896/2. URL: http://intranet.ustavkonstruovani.cz/file-download/get-project-pdf/393. **(software)**

TEACHING

- ~~3CD (2017) CAD~~

- 1K Fundamentals of Machine Design
- ? ZKP (5x) Team Project
- 0ZP (od 2017) Aventics Pneumobile Racing

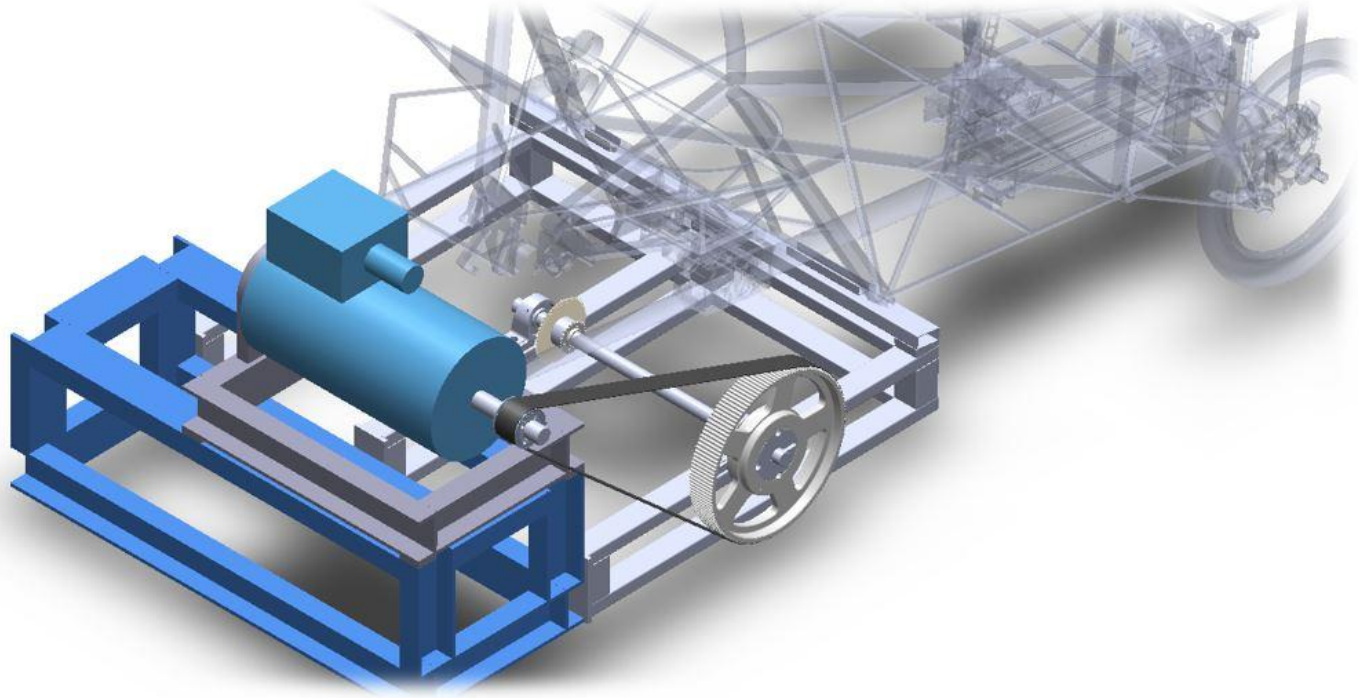
- 2K Machine design
- ~~ZIP (1x) Mechanical Design Project~~
- ~~QEM Experimental Methods~~

- BP (1x)

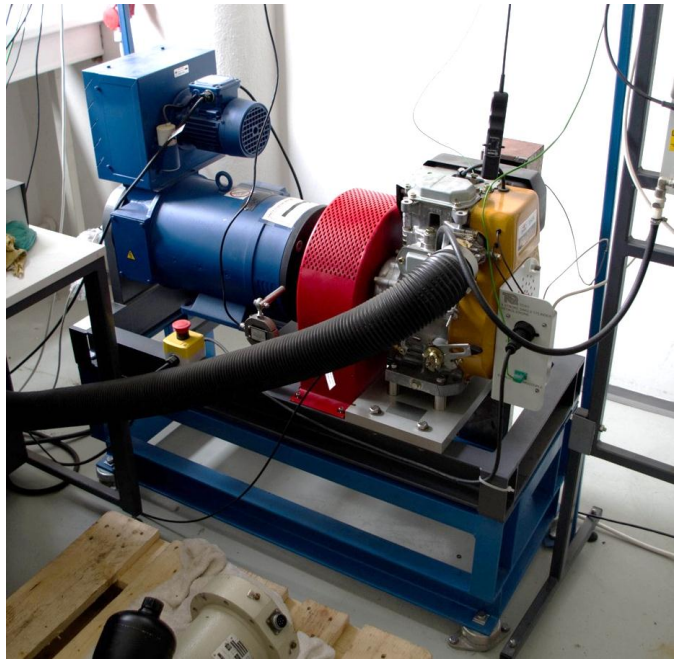
TEACHING

BP – Pneumobile dynamotester desing

- redesing of educational dynamo tester
- Matyáš Fritscher



Concept of pneumobile dynamotester

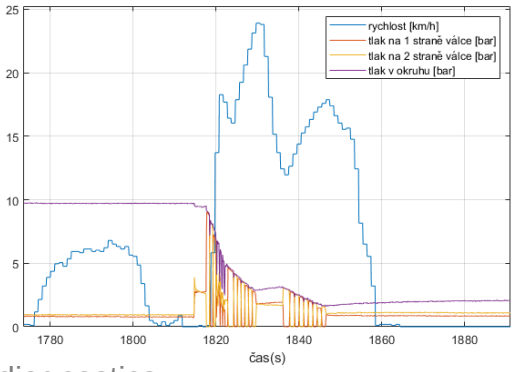


Educational dynamotester

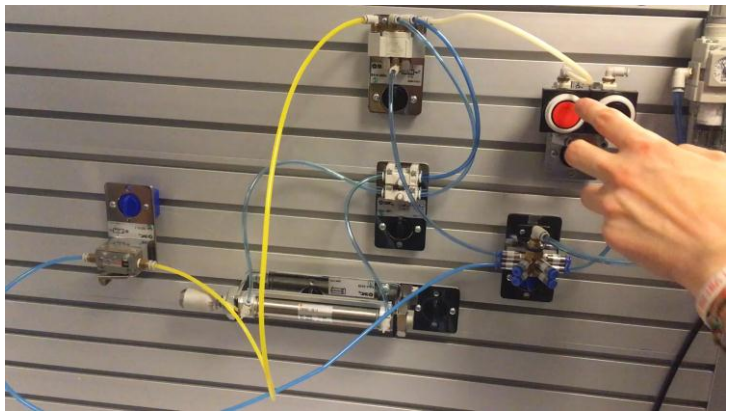
TEACHING

0ZP

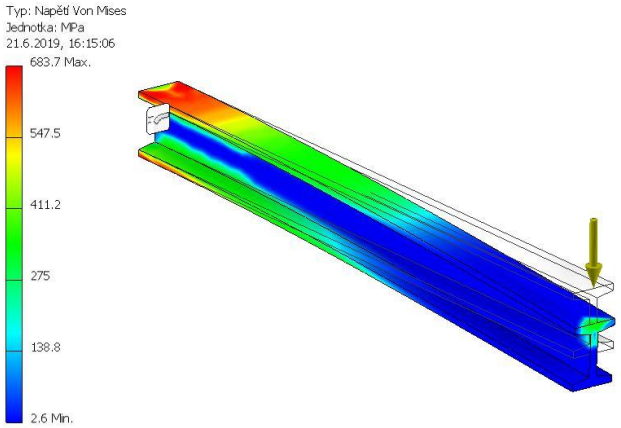
- pneumobile acquaintance – 1 week
- pneumatic systems (SMC) – 4 weeks
- SolidWorks – 3 weeks
- FEM basics – 1 week
- racing car construction (doc. Mazůrek) – 1 week
- arduino (Dr. Strecker) – 1 week
- pneumobile diagnostics – 1 week



diagnostics

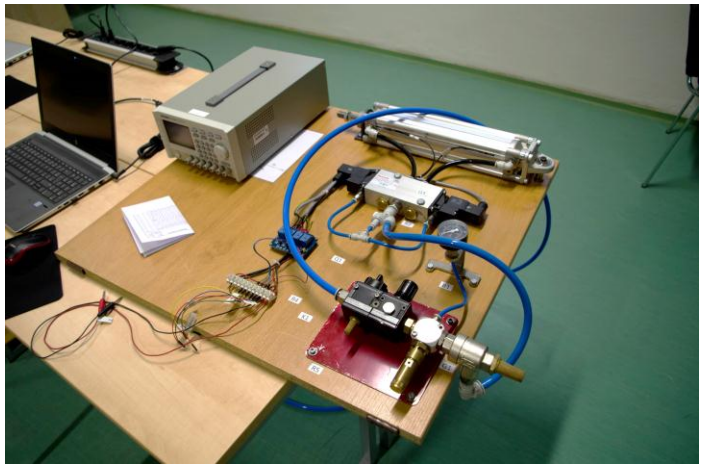


SMC – pneumatic systems



FEM

SolidWorks



Arduino

TEACHING

Feedback

Odpovědi	S vyučujícím jsem byl spokojen. /********/

Odpovědi	Vše v pořádku, zasloužil by zvednout plat. /********/

Odpovědi	Milý učitel, který rád pomůže nebo poradí. /********/ Podle mě je pan Jeniš jeden z nejlepších cvičících na 1K, byl fajn. /********/

Thanks for your attenion

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