



Contents of Work Package WP04VaV Advanced Vehicle Transmissions

WP04: Pokroková převodná ústrojí vozidel

Coordinator of the WP

České vysoké učení technické v Praze, responsible Gabriela Achtenová

Participants of the WP

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Technická univerzita v Liberci R. Voženílek

Main Goal of the WP

New concept of mechanical automated gearboxes. Optimization of internal disposition leading to silent transmissions and automated transmission with fast gear change

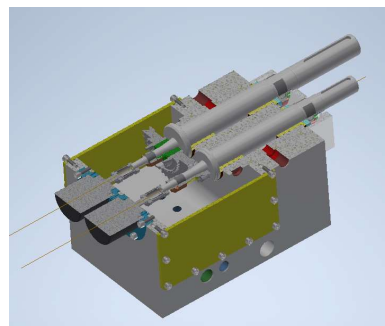
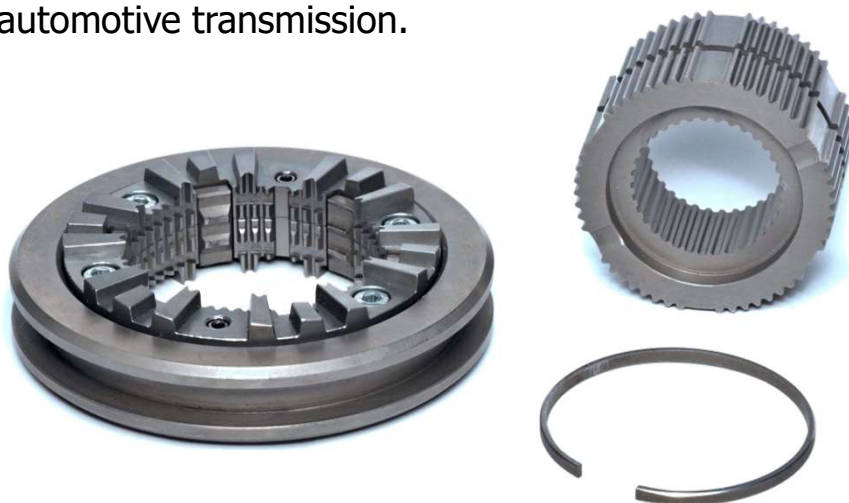
Partial Goals for the Current Period

- Automated gearbox with fast and comfort gearshift
- Detection of noise and vibration sources
- Possible improvements and changes leading to diminution of gbx noise

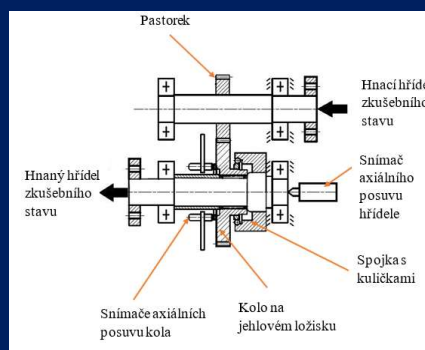
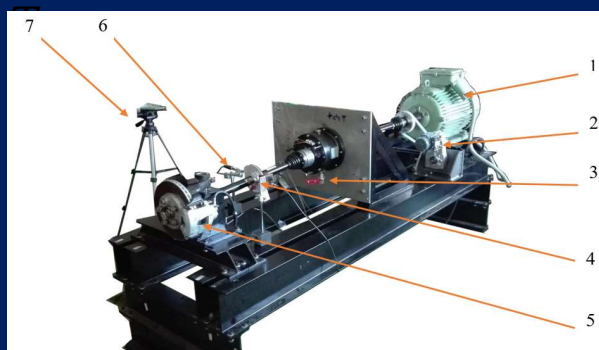


Activities in WP04VaV Advanced Vehicle Transmissions

Dog clutch for easy automation. No angular clearance. Fast and comfort shift capability. Built in and tested in automotive transmission.



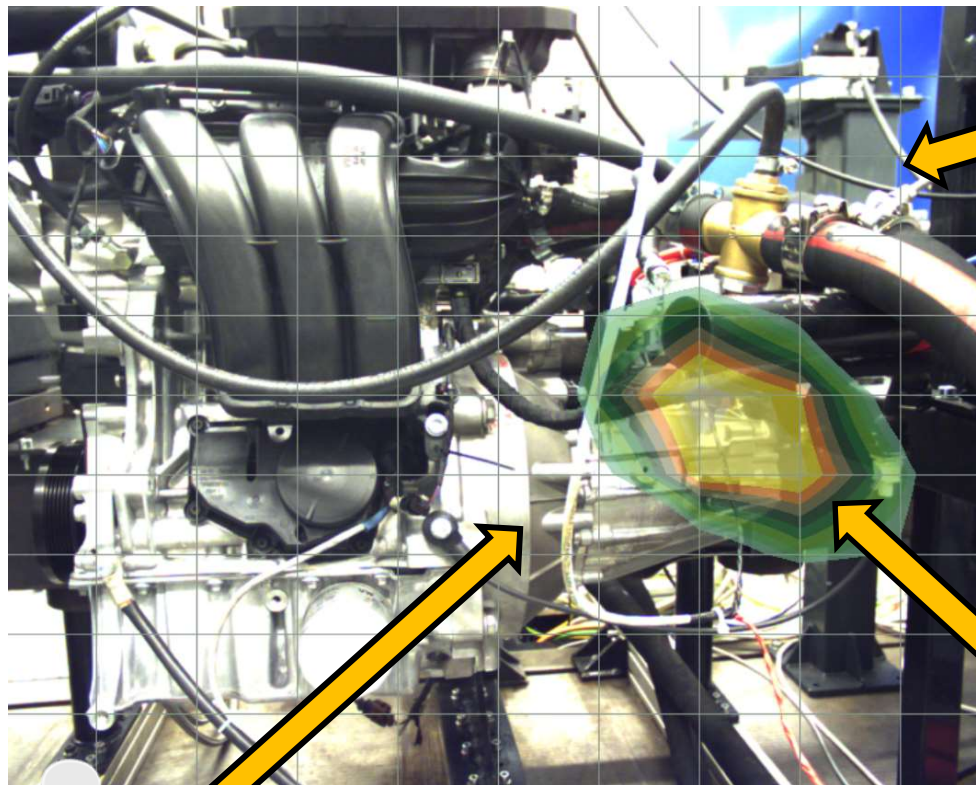
Testing device for transmission error, noise and vibration measurement based on a closed circuit with replaceable test wheels.



Measurement instrument for the analysis of the behavior of gearwheels on rolling elements. The goal will be the possibility to measure gearwheel tilting at presence and absence of synchronizing rings.



Activities in WP04VaV Advanced Vehicle Transmissions



The modification of the test stand frame to be similar to the stiffness of the powertrain mounting points in the vehicle



Changing gearbox features



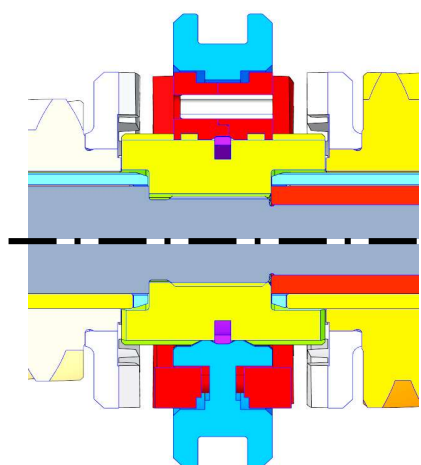
Measuring events in the powertrain / FEM simulation



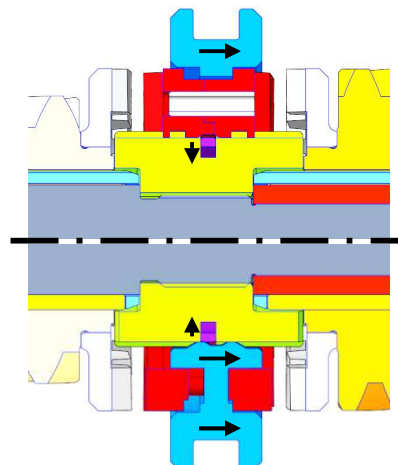
Activities in WP04VaV Advanced Vehicle Transmissions

Functional principle of dog clutch = the internal gearshift mechanism optimised to achieve the minimal shifting time for shift comfort improvement. Zero angular backlash.

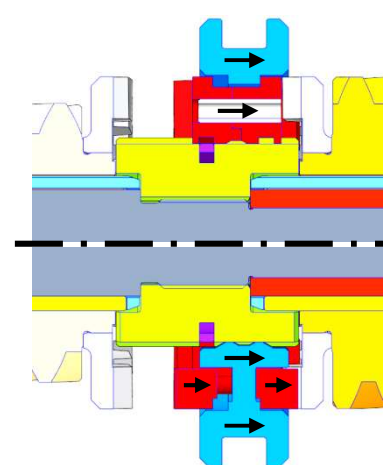
Explanation of main shift phases



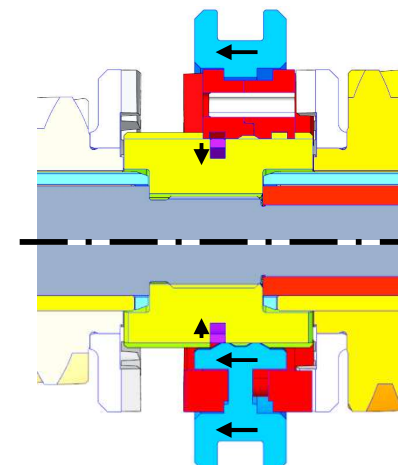
Neutral



Engagement
preparation. Unlock
from neutral position



Engagement
termination. The
gear in shifted
position fully locked

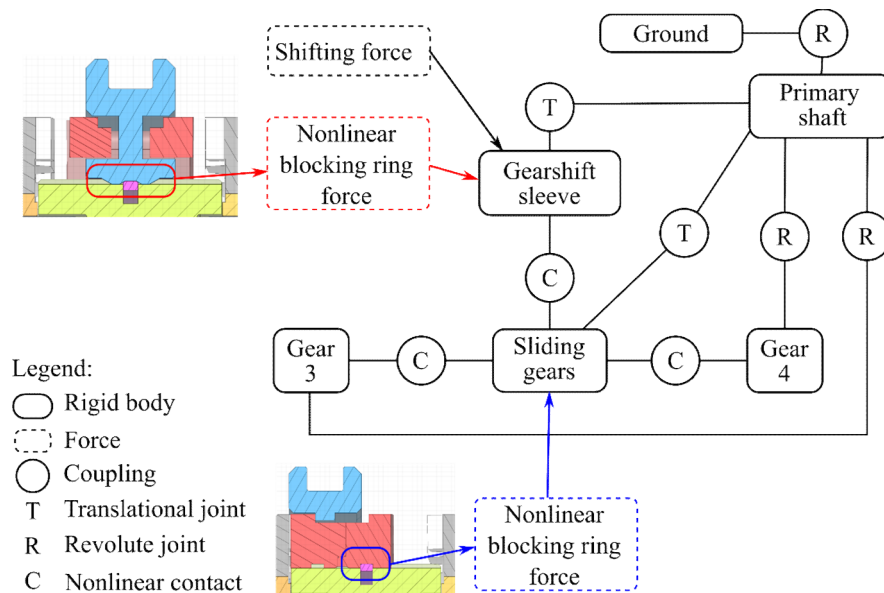


Disengagement
preparation. The
sleeve unlocks the
blocking ring.

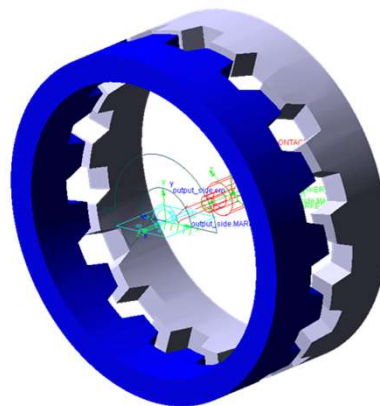
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Activities in WP04VaV Advanced Vehicle Transmissions



*Kinematical scheme
of the created multi-body model*

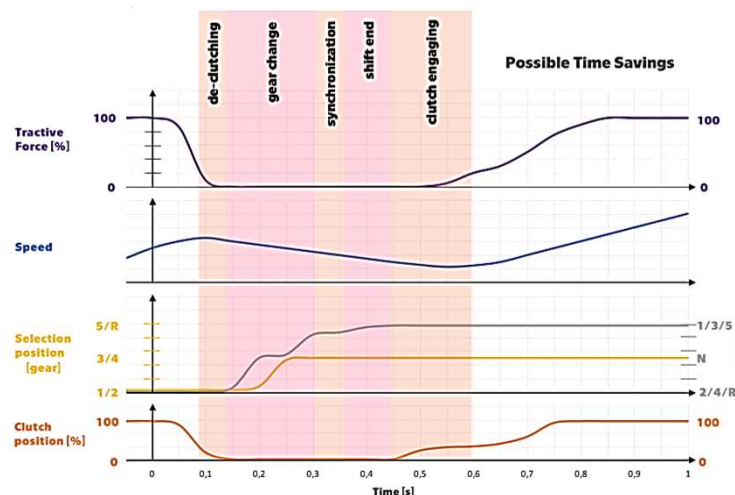


Advanced gearshift multibody simulation model

- Includes whole dog clutch for 3rd/4th gear and MQ200 input shaft
- Blocking ring as flexible part
 - Model measures the gearshift force due to the blocking ring deformation
 - Suitable for optimization of blocking ring size and shape
- Main output is gearshift time
 - Start: Gearshift force is applied
 - End: Blocking ring extends into gearshift sleeve, gear is secured



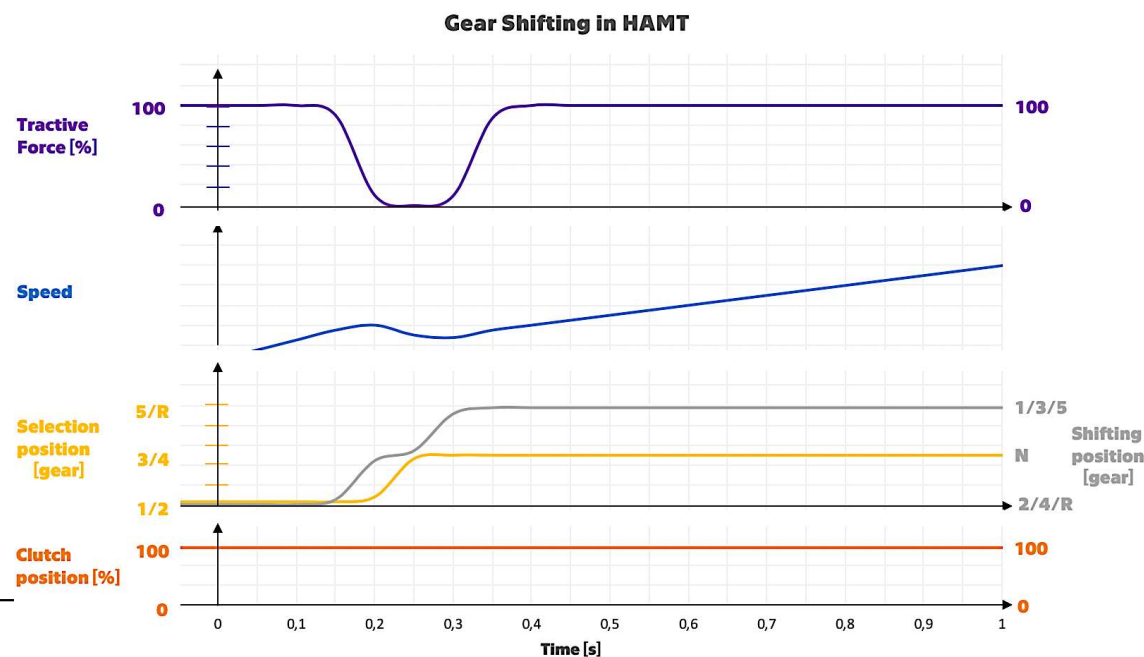
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Detailed observation and elaboration of different shift phases => determination of the longest phases which should be avoided for fast automated gear shift.

Synchronisation is faster than selection movement.
Unfortunately it is not because of high inertia moment

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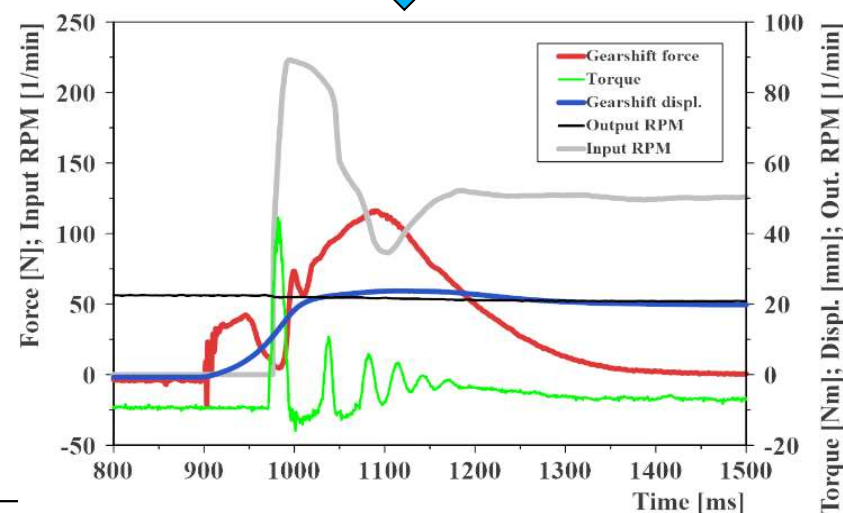


Activities in WP04VaV Advanced Vehicle Transmissions

Built of the prototype.
Integration of dog shift clutches in
the automotive gearbox



Test on the
inertia test
stand



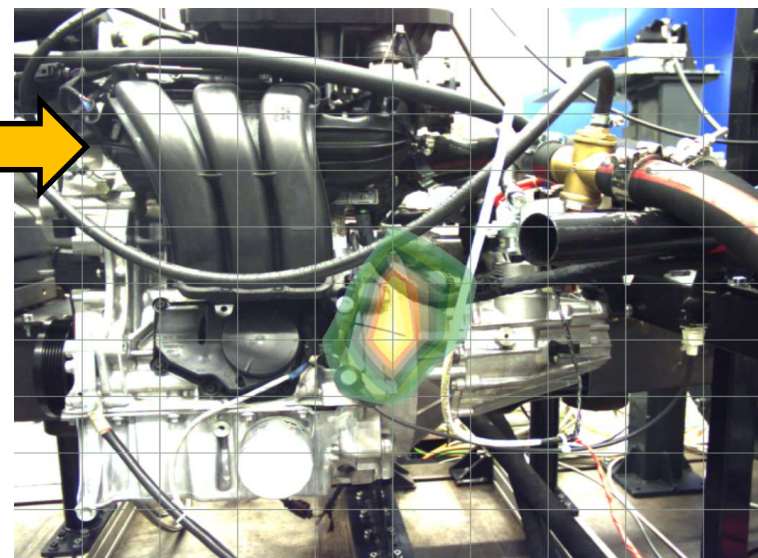
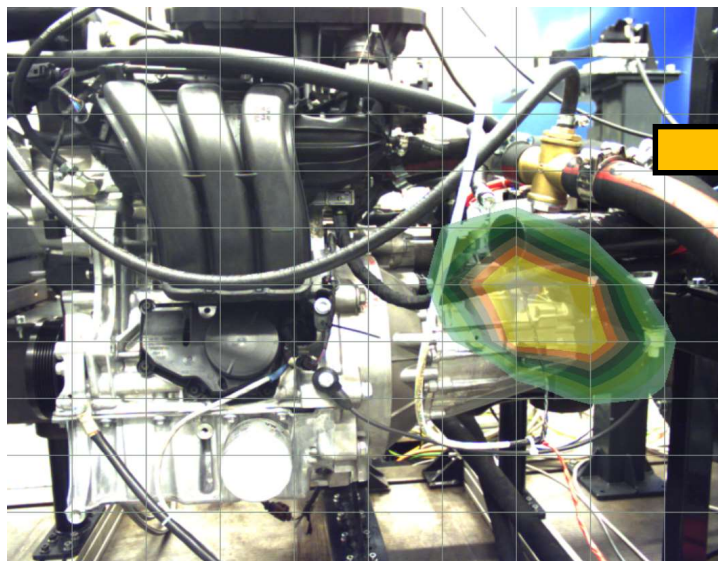
Measurement
results.
Promosing
behavior.

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Activities in WP04VaV Advanced Vehicle Transmissions

Technical demonstrator of gearbox casing with improved acoustic insulation



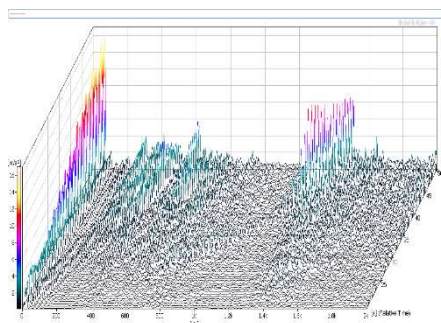
Adjust local features of gearbox by adding extra mass to reduce acoustic emission

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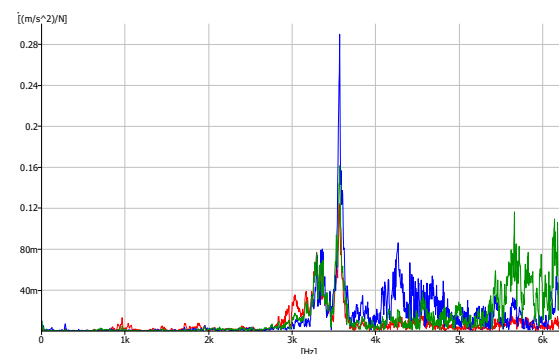


Activities in WP04VaV Advanced Vehicle Transmissions

Technical demonstrator of gearbox casing with improved acoustic insulation

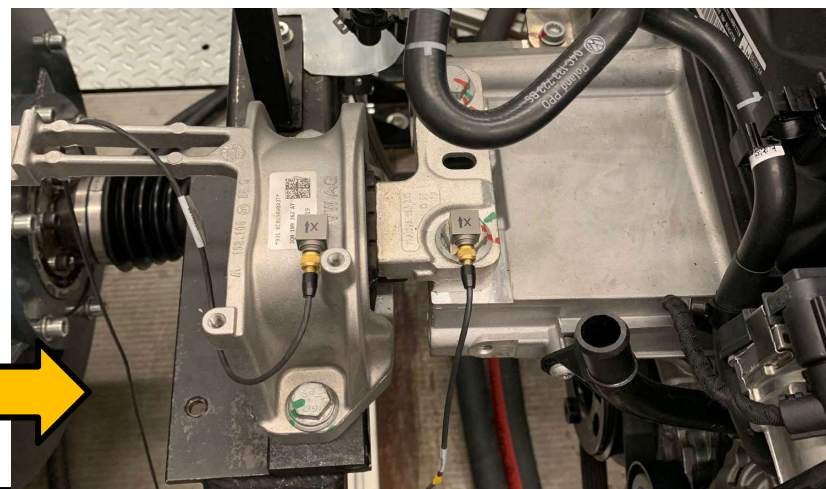


Vibration multispectrum



Frequency Response function

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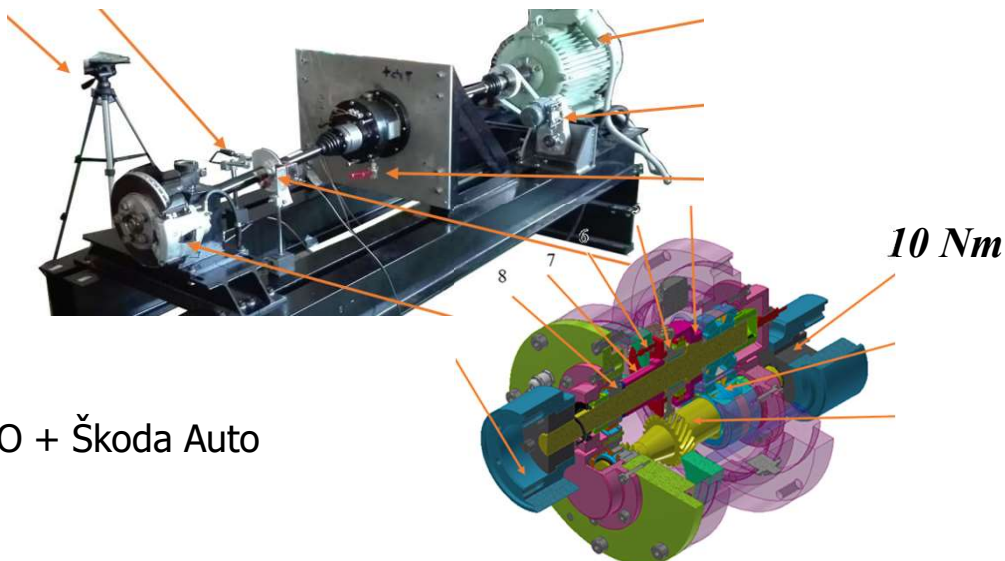




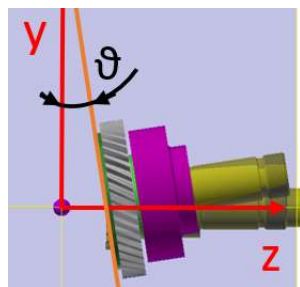
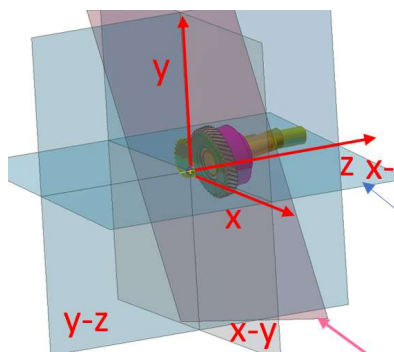
Activities in WP04VaV Advanced Vehicle Transmissions

Measurement instrument for the analysis of the behavior of gearwheels on rolling elements

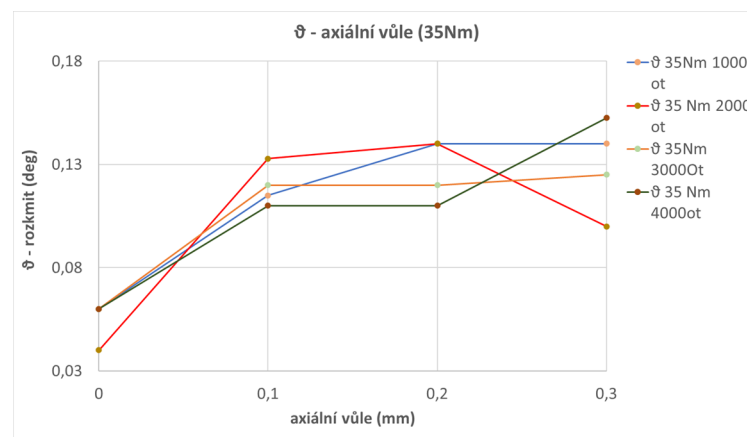
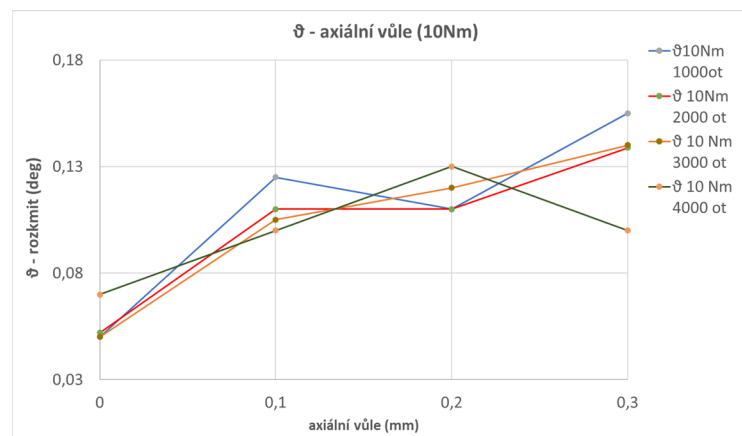
Wheel swing comparison



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35 Nm

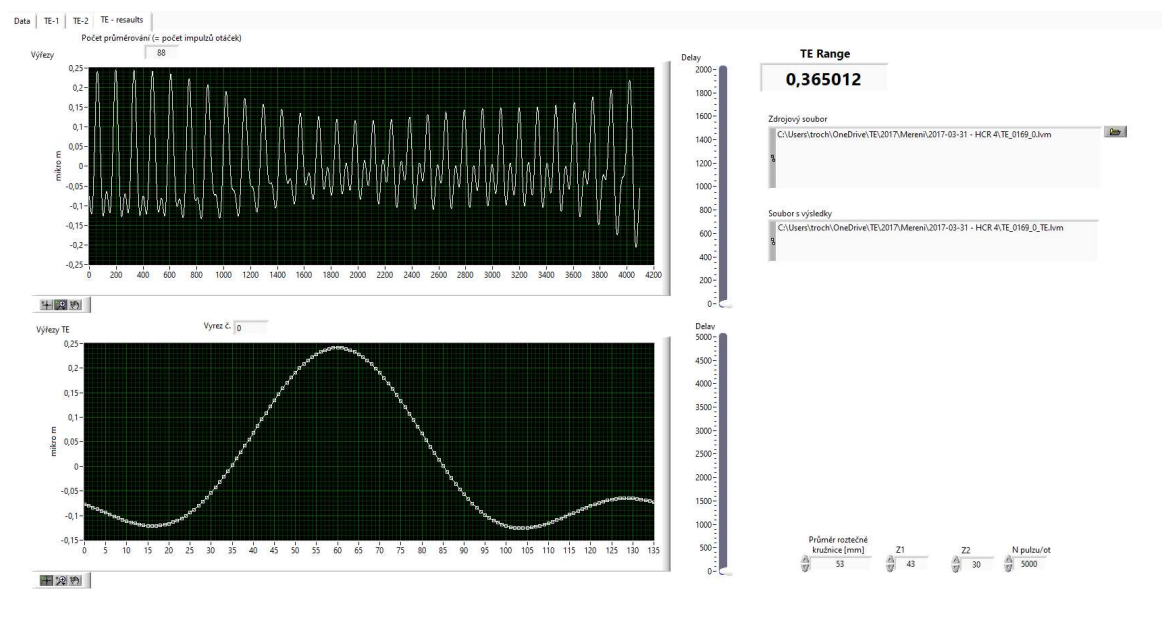




Activities in WP04VaV Advanced Vehicle Transmissions



Equipment for transmission error analysis and measurement of noise and vibration emissions



A beta version of the software is being processed NI LabView programming environment

Realized parts of gearboxes and connecting parts.

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Fulfillment of goals and deliverables of WP04VaV Advanced Vehicle Transmissions

Current State of Deliverables, Milestones and Fulfillment of Goals

1-WP04-001

The functional specimen of gearbox fully equipped with all dog clutches ready to improve automated gearshift will be assembled in Dec. 2020

1-WP04-002

Test stand for transmission error measurements, will be fully finished in Dec. 2020

1-WP04-003

Measurement instrument for the analysis of the behavior of gearwheels on rolling elements; accomplished.

1-WP04-004

Software for transmission error analysis and measurement of noise and vibration emissions; will be fully finished in Dec. 2020

1-WP04-005

The aim is just about to be completed - The technical demonstrator of gearbox casing with improved acoustic insulation will still be verified by the last measurements in December 2020.

1-WP04-006

The functional specimen of gearshift clutch is completed.



Fulfillment of goals and deliverables of WP04VaV Advanced Vehicle Transmissions

List of Due Deliverables and Their Added Value

Gearbox with improved actuation for smooth shift control.

If the potential of concept will be approved, it will offer important concurrent with 50 to 75 % of price of the automatic gearbox and the same functionality.

Test stand for transmission error measurement and stand for analysis of gearwheels on rolling elements

The heart of any gearbox of any powertrain are gearwheels. The result serve to detection of noise emission and to research of the ways how the NVH properties of the geared transmissions can be improved.

The test stand for gbx NVH measurement

Crucial is prepare laboratory measurements giving the same value, like in real vehicle to observe and minimise the NVH of the whole powertrain.



Current contribution of WP04VaV Advanced Vehicle Transmissions

Assessment of the Contribution of Deliverables

Gearbox with improved actuation for smooth shift control.

The dog clutch offers unique usage in many transmission types. The real potential can be easier predict after all tests, including the endurance test. The capabilities can be further elaborated with help of research projects of future powertrains and industrial contracts

Test stand for transmission error measurement and stand for analysis of gearwheels on rolling elements

The potential is in methodology for design of quiet gearwheels and impact of gearwheel placement on NVH. The usage is envisaged mainly through industrial contracts.

The test stand for gbx NVH measurement

Ones the technology will be settled, the usage is envisaged mainly through industrial contracts..



WP04VaV Advanced Vehicle Transmissions

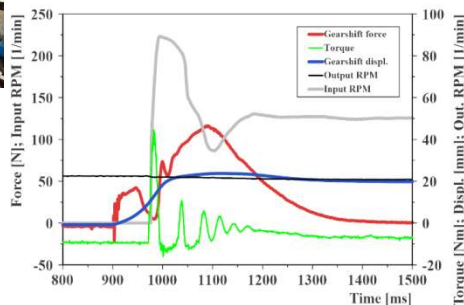
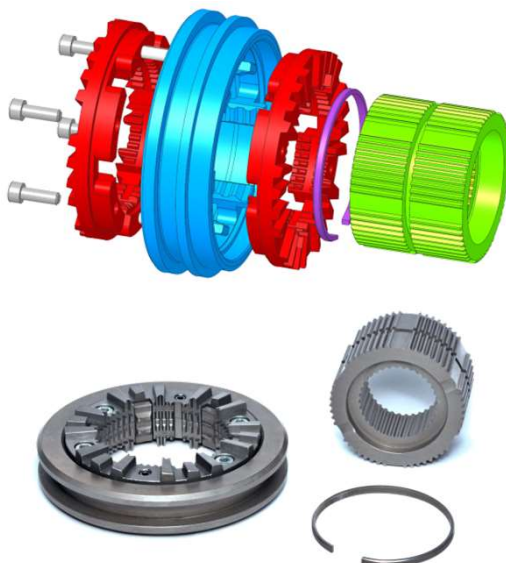
Thank you for your attention



Výtah z prací 2019-2020 na WP04VaV Pokročilé automobilové převody

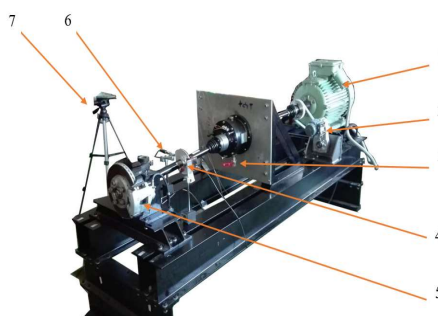
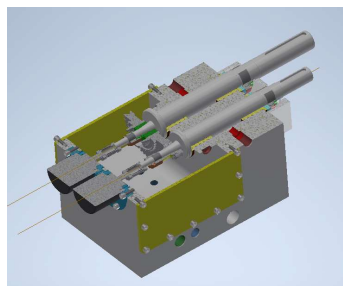
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Gabriela Achtenová



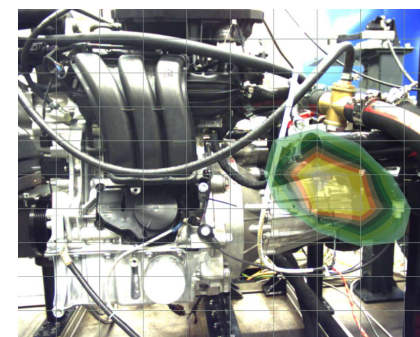
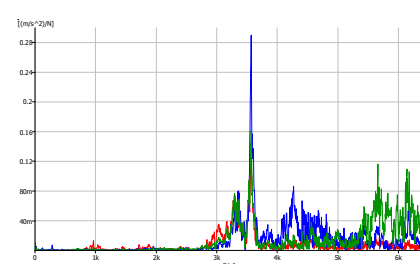
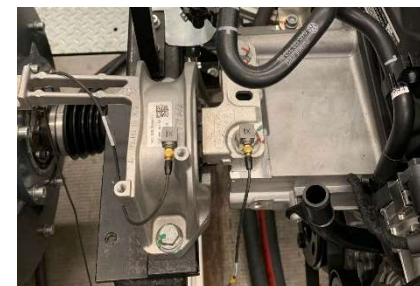
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Zdeněk Foltá



ŠA + TUL: experimentální výzkum

Robert Voženílek

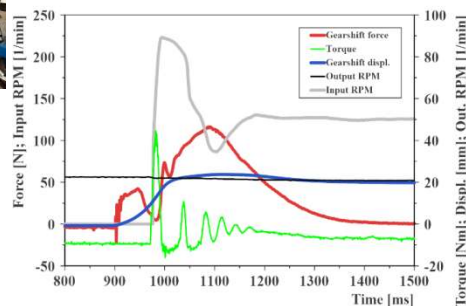
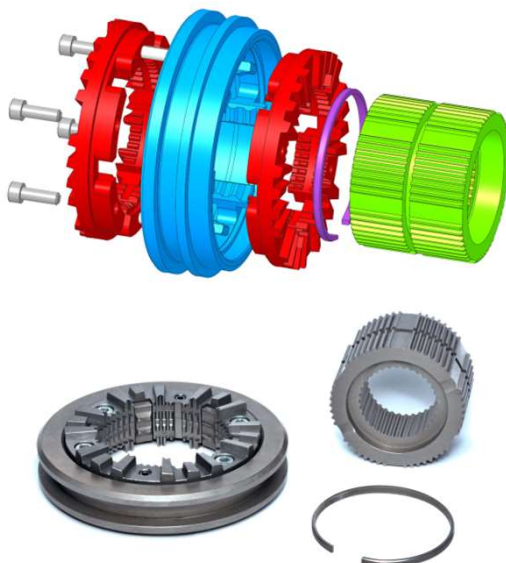




Results of WP04VaV Advanced Vehicle Transmissions –Achieved 2019-2020

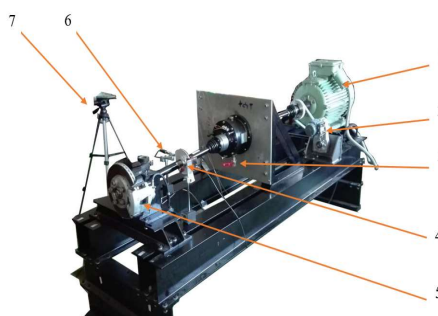
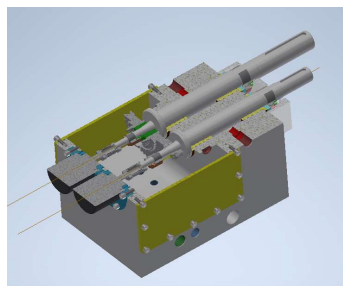
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