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Characterisation of velocity dependent flow-curves and yield-surfaces

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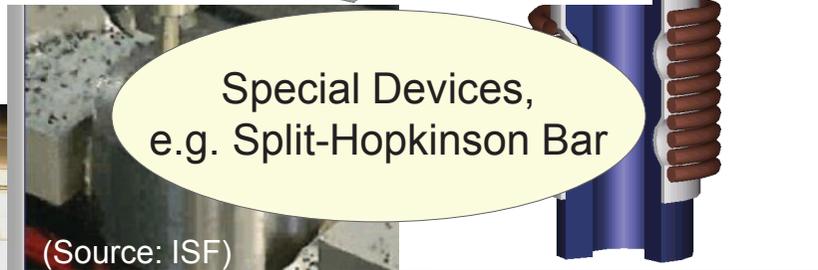
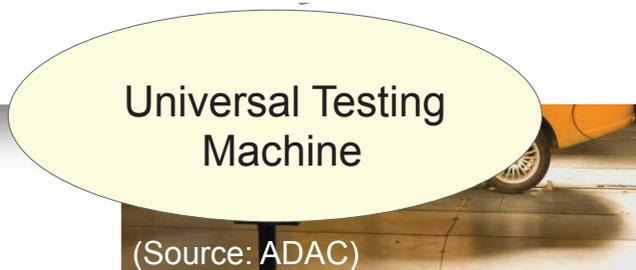
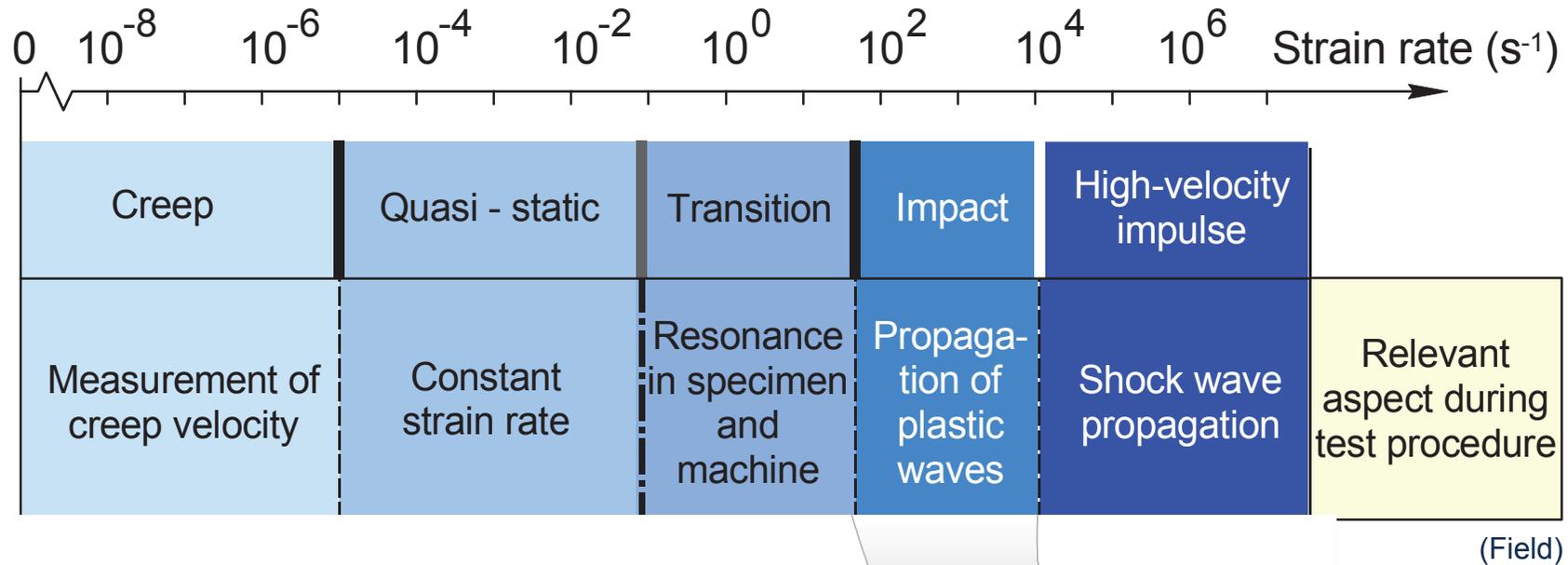
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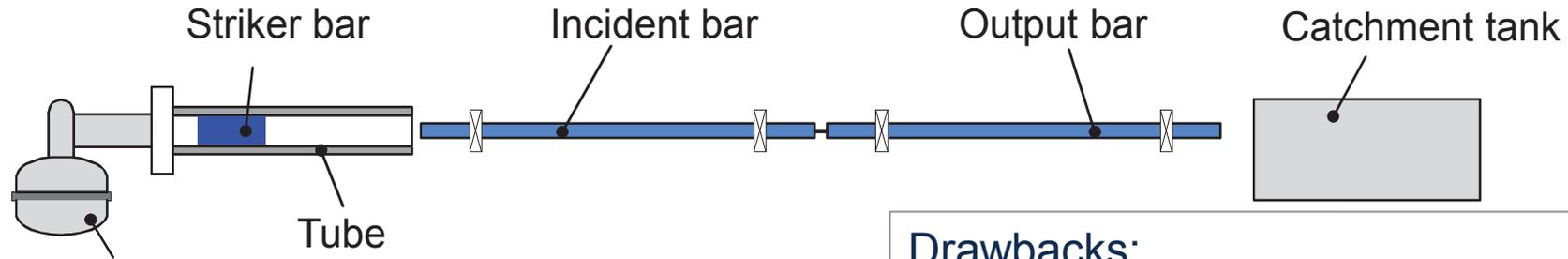


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concept
Exzellenz aus
Wissenschaft
und Kultur

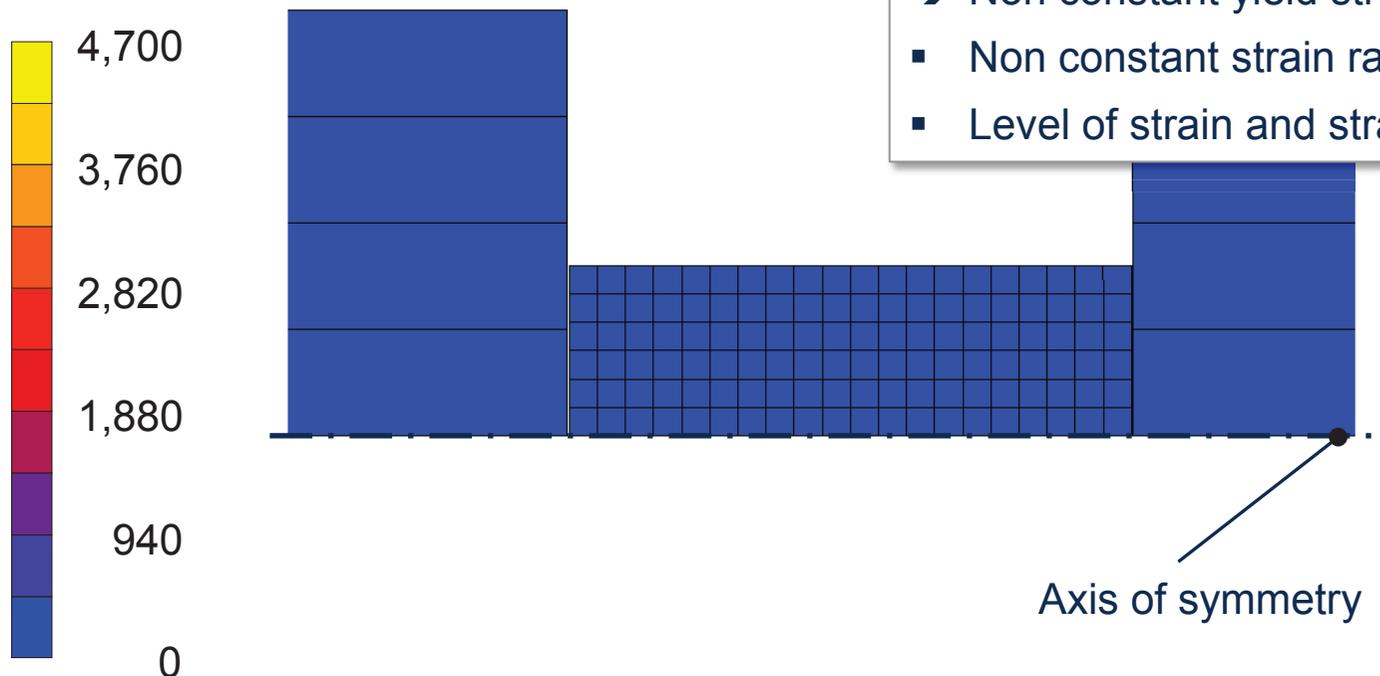


- Introduction
- Principles
 - Electromagnetic accelerated tools
 - Pneumatic accelerated tools
 - Measurement principle of force and displacement
- Parameter identification schema
- Results and summary





Strain rate $\dot{\phi}$ in s^{-1}



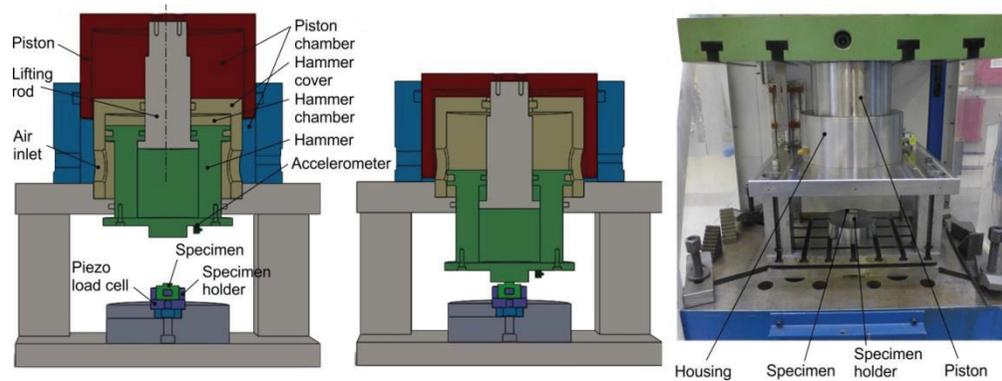
Drawbacks:

- Stress and strain waves in specimen
- ➔ Non constant yield stress level
- Non constant strain rate during process
- Level of strain and strain rate is coupled

Axis of symmetry

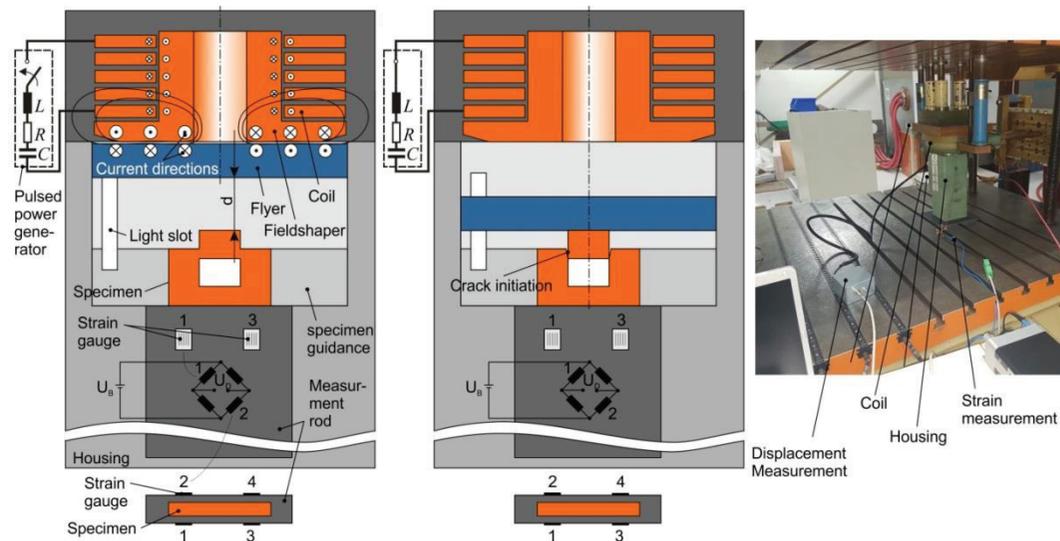
Pneumatic

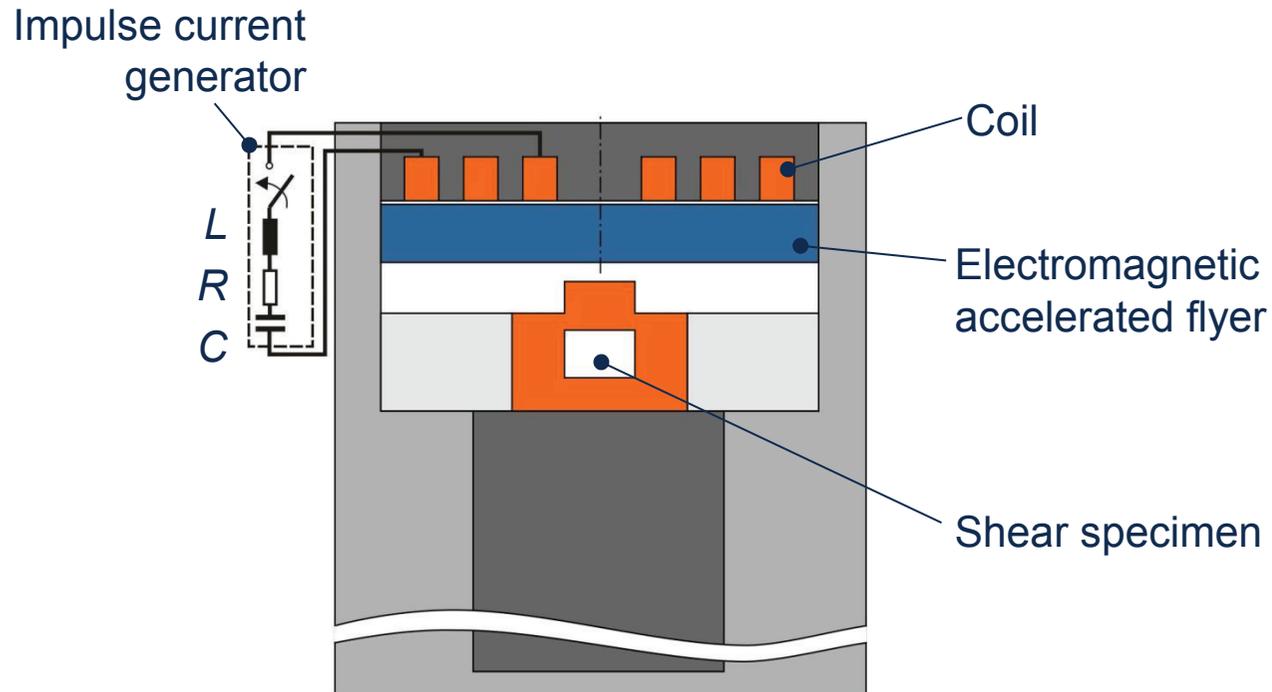
- hammer velocity
up to 15 m/s
- specim. strain rate:
up to 1500 s⁻¹

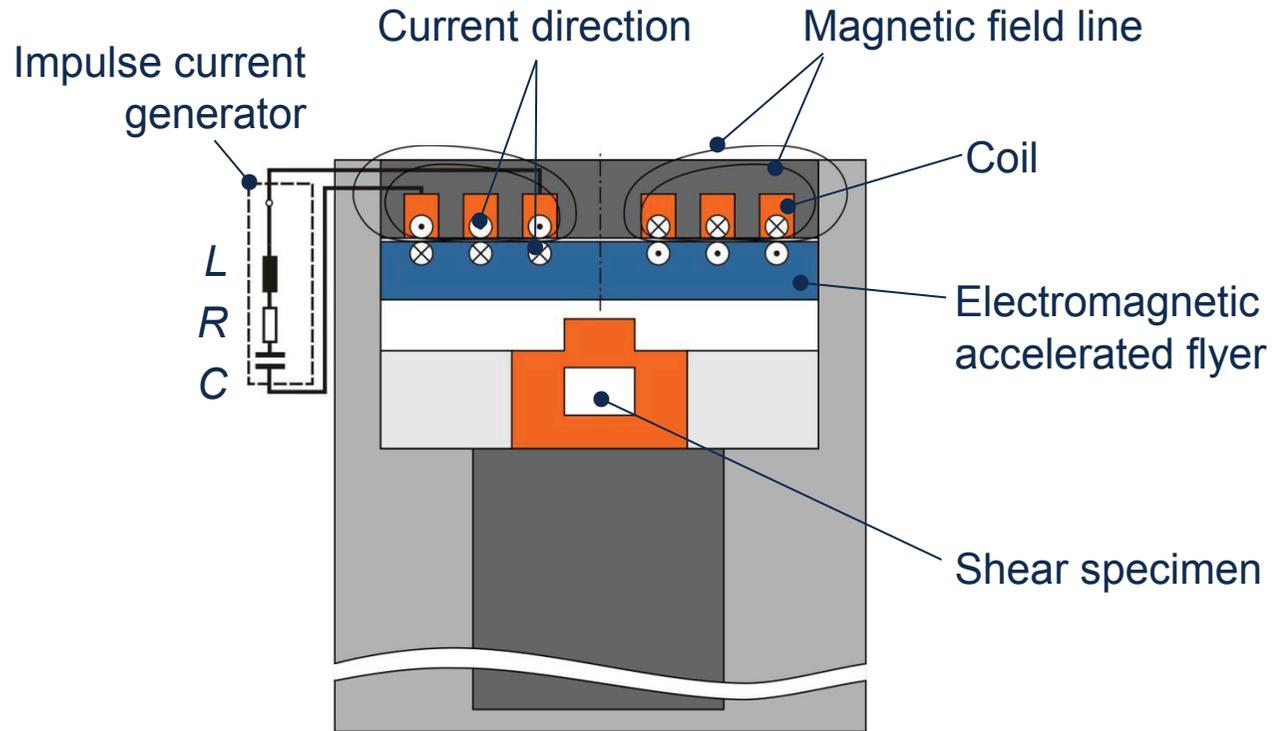


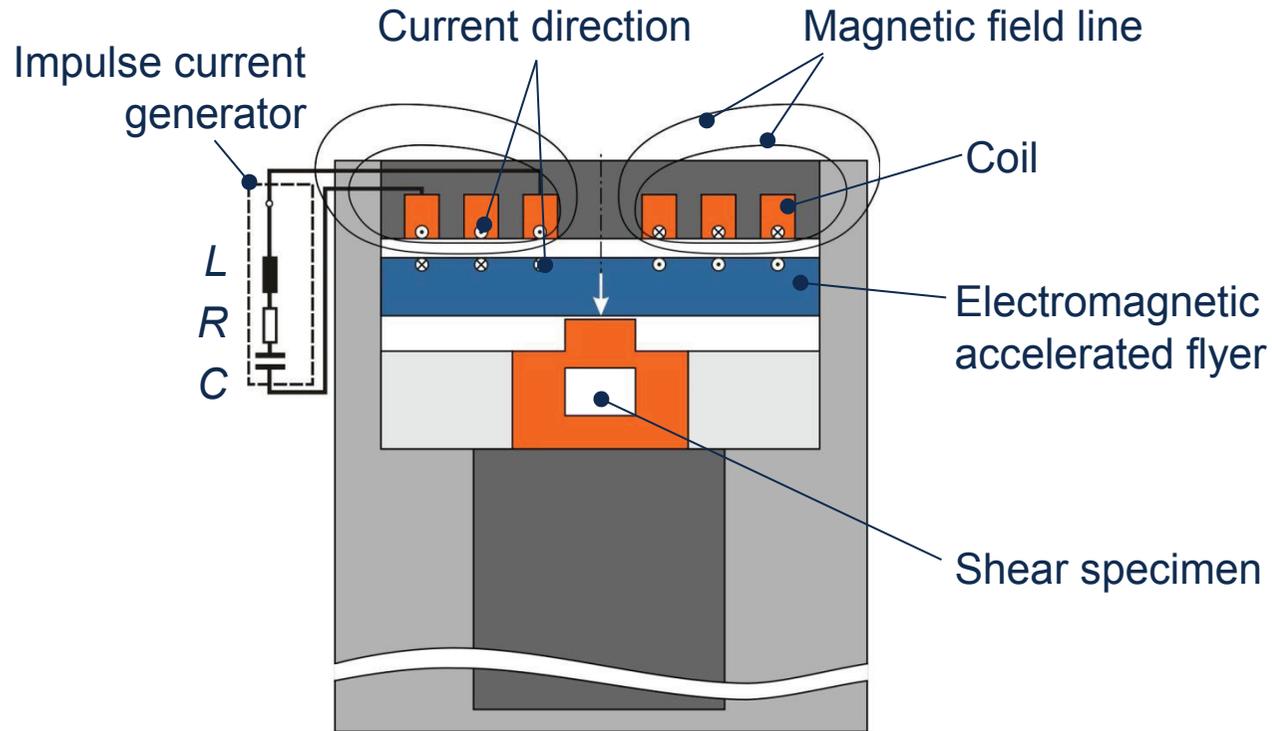
Electromagnetic

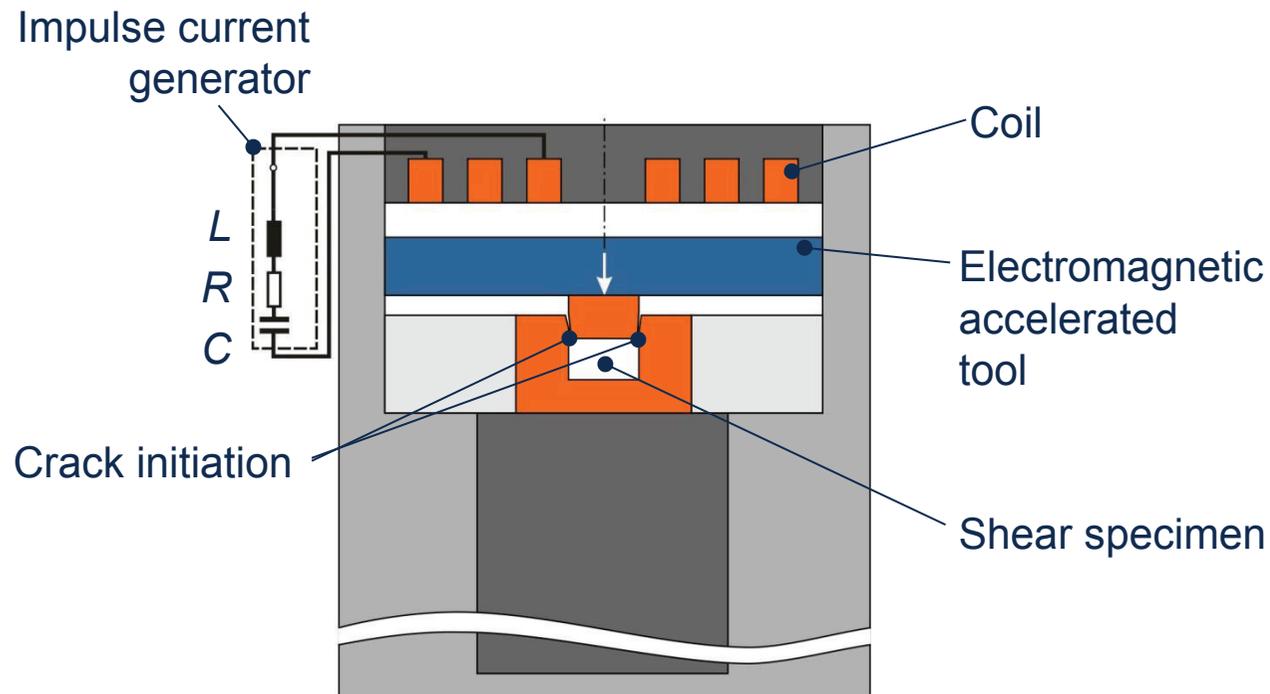
- hammer velocity:
up to 70 m/s
- specim. strain rate:
up to 10⁵ s⁻¹





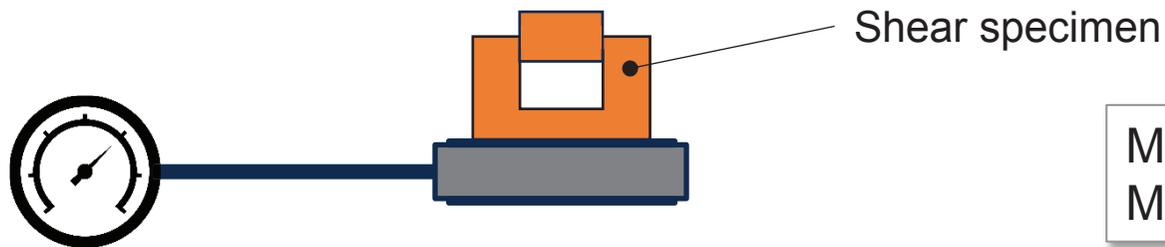
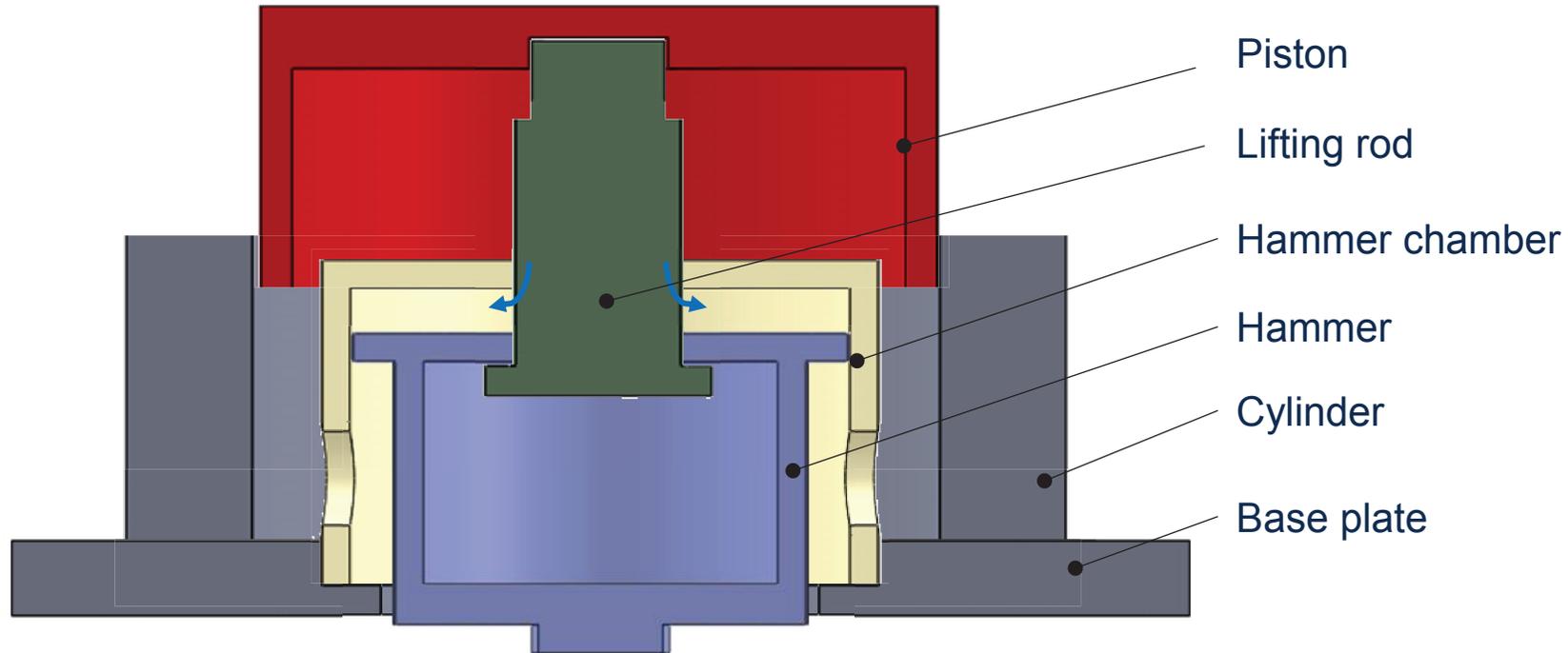




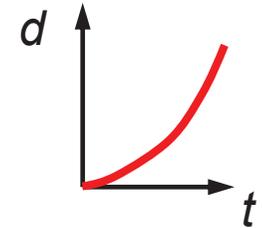


Max. strain rate $\approx 10,000 \text{ s}^{-1}$
 Max. tool velocity $\approx 70 \text{ m/s}$

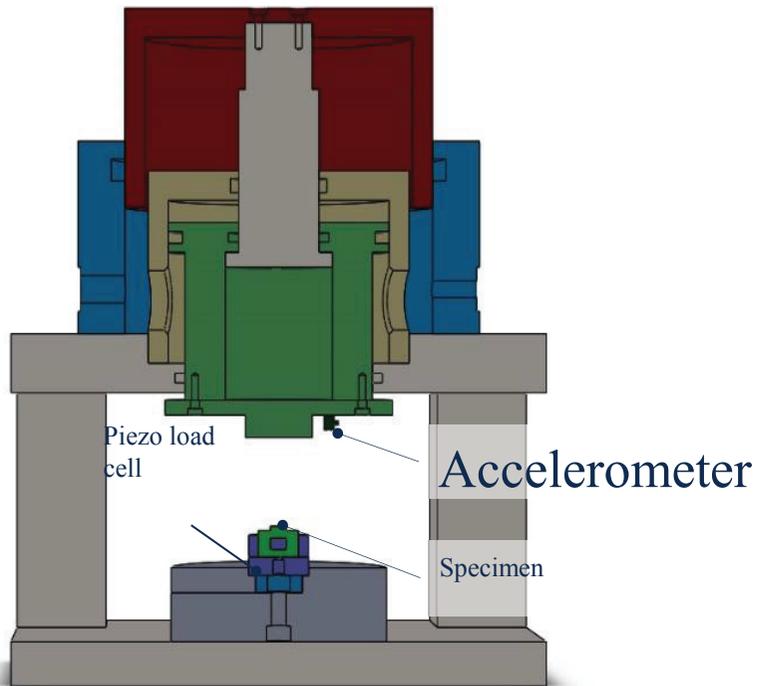
Pneumatic Accelerated Tool System Principle



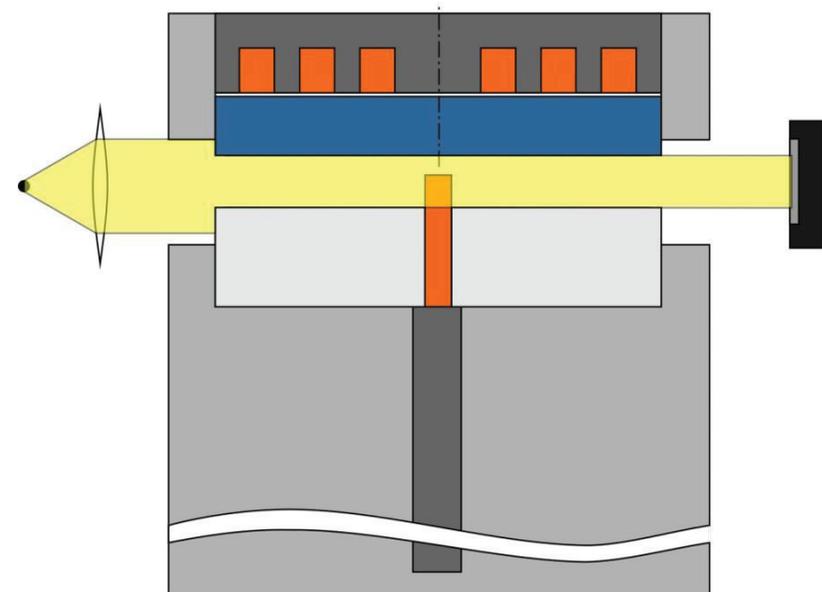
Max. strain rate $\approx 1,500 \text{ s}^{-1}$
 Max. tool velocity $\approx 15 \text{ m/s}$



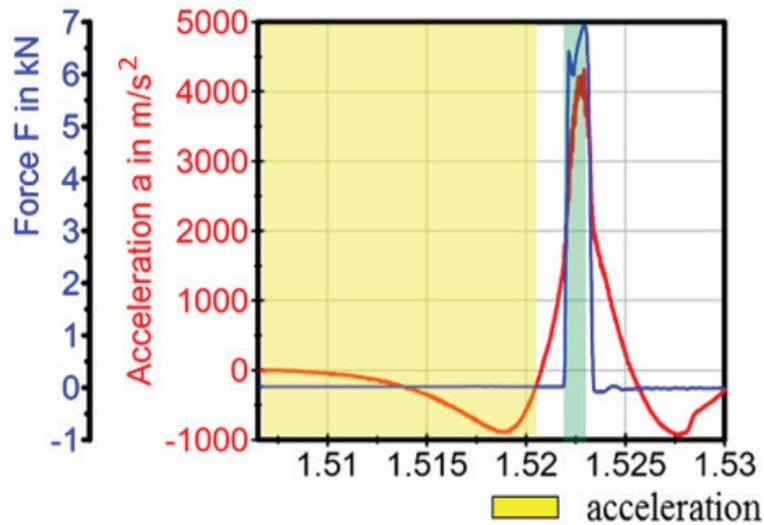
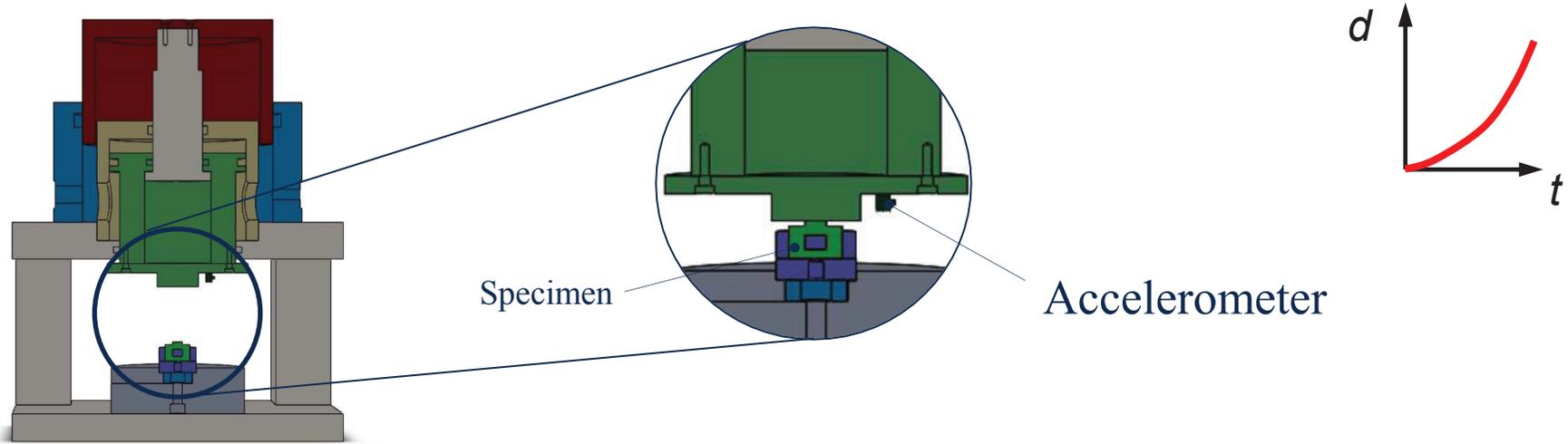
Acceleration



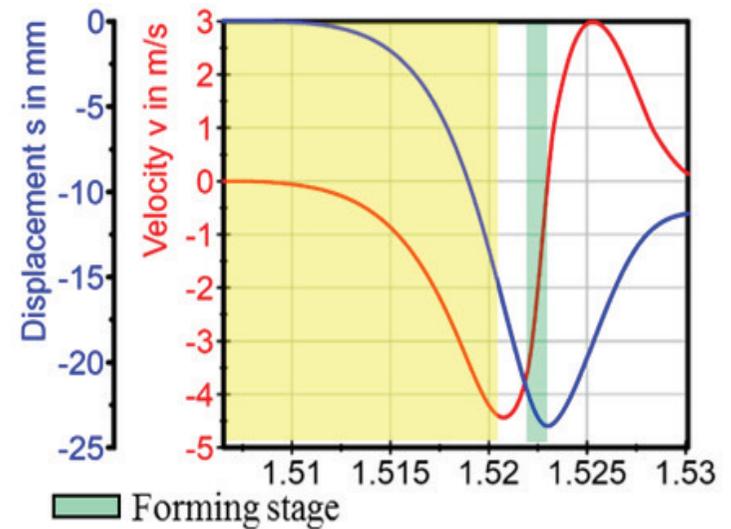
Shadowing principle



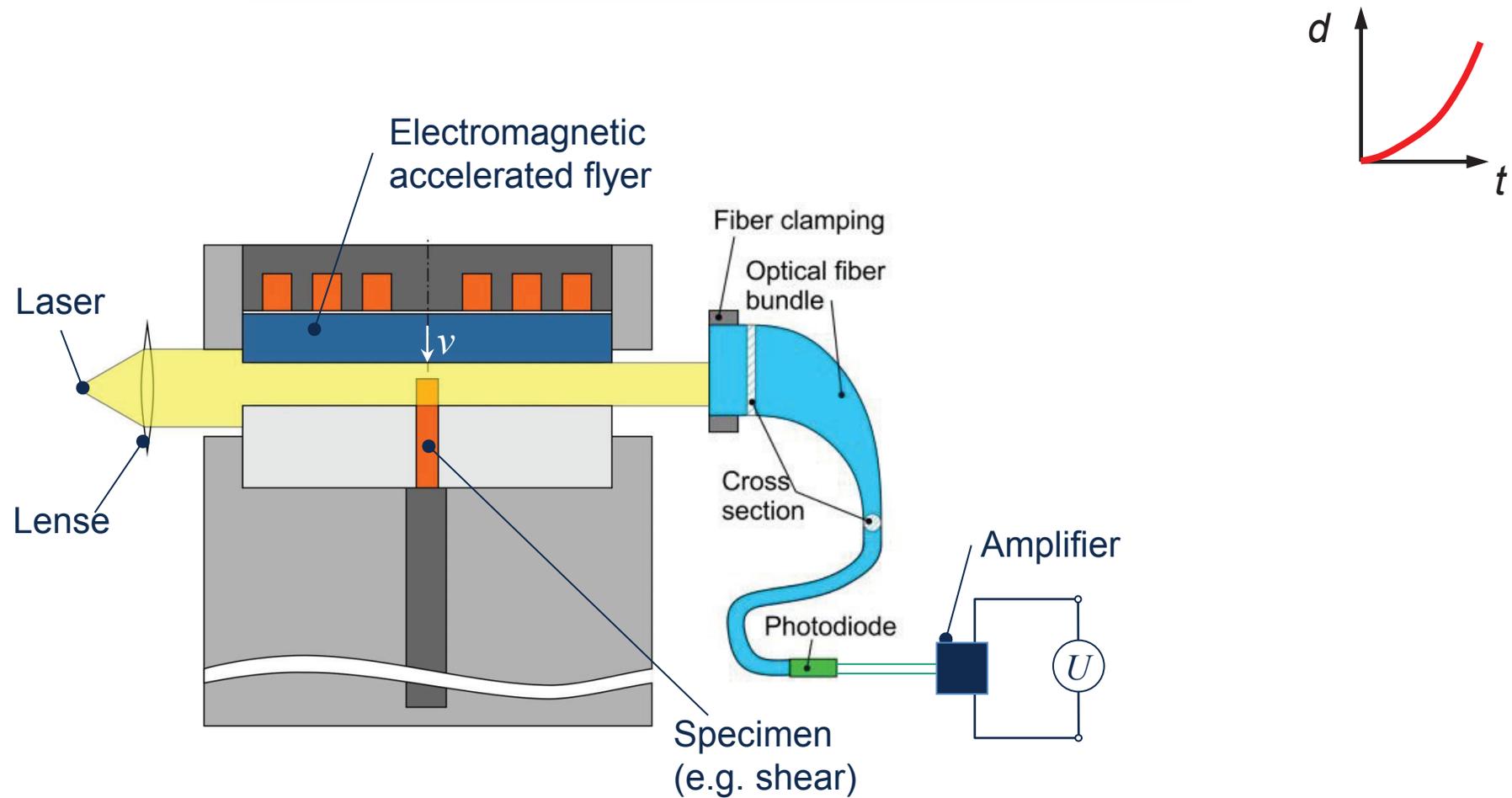
Measurement Principle – Displacement Accelerometer

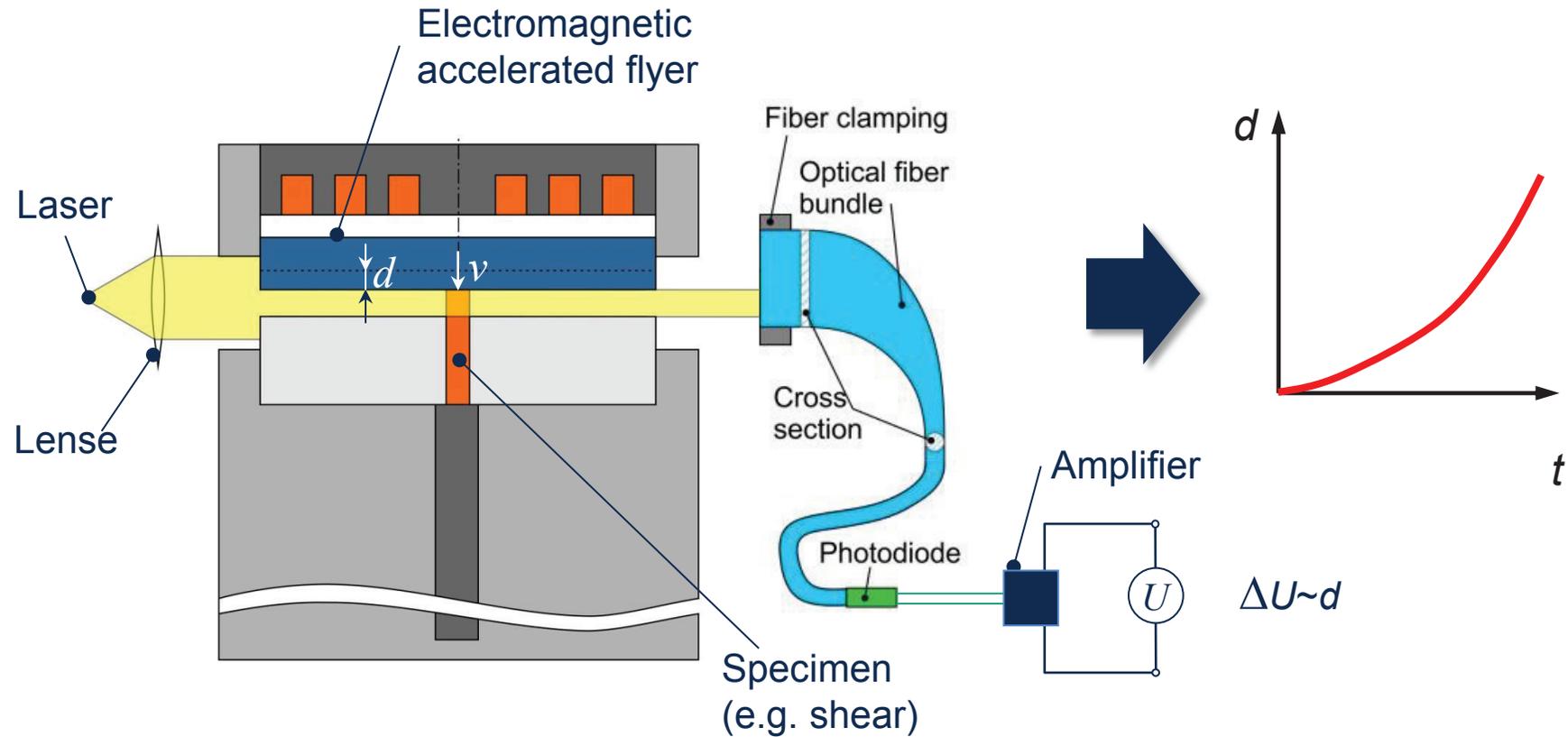


$$\iint dt$$



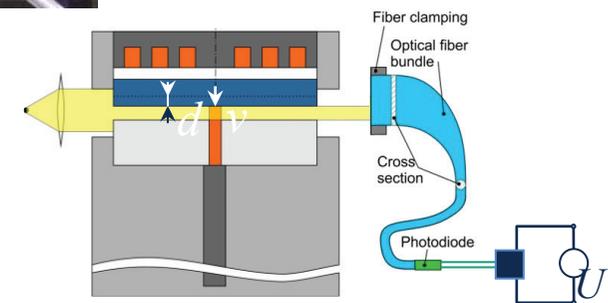
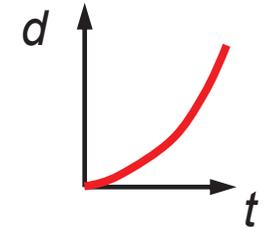
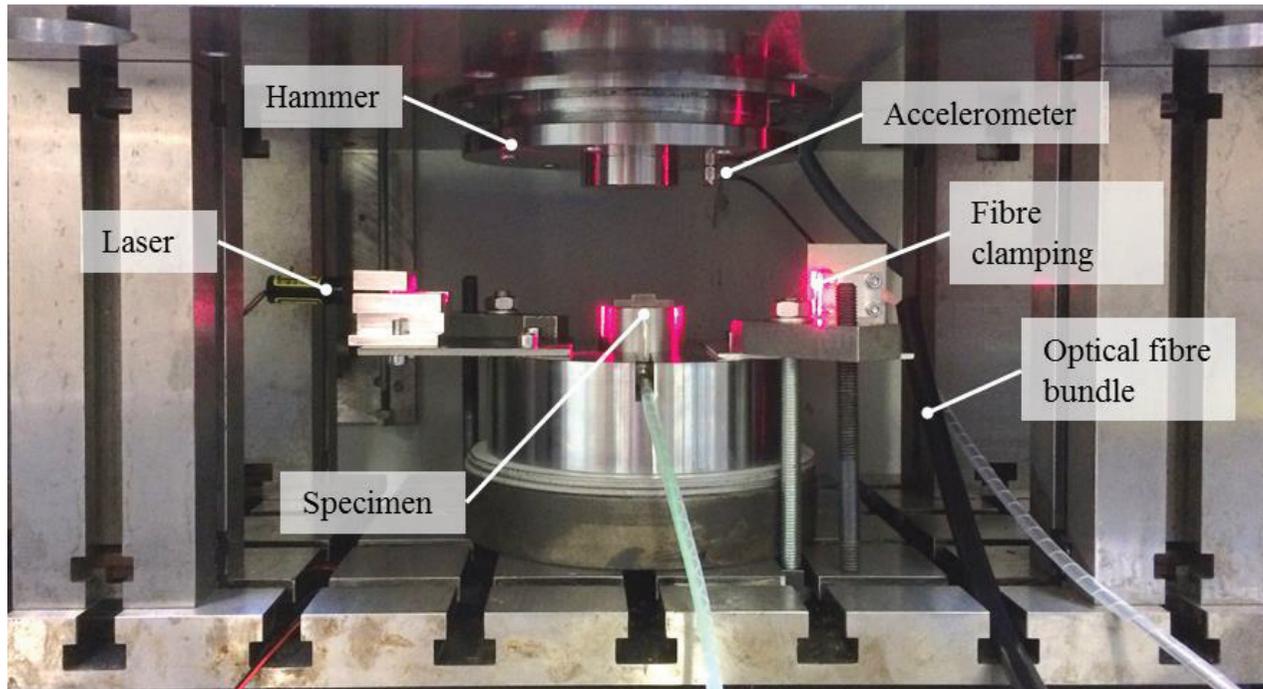
Measurement Principle – Displacement Shadowing principle

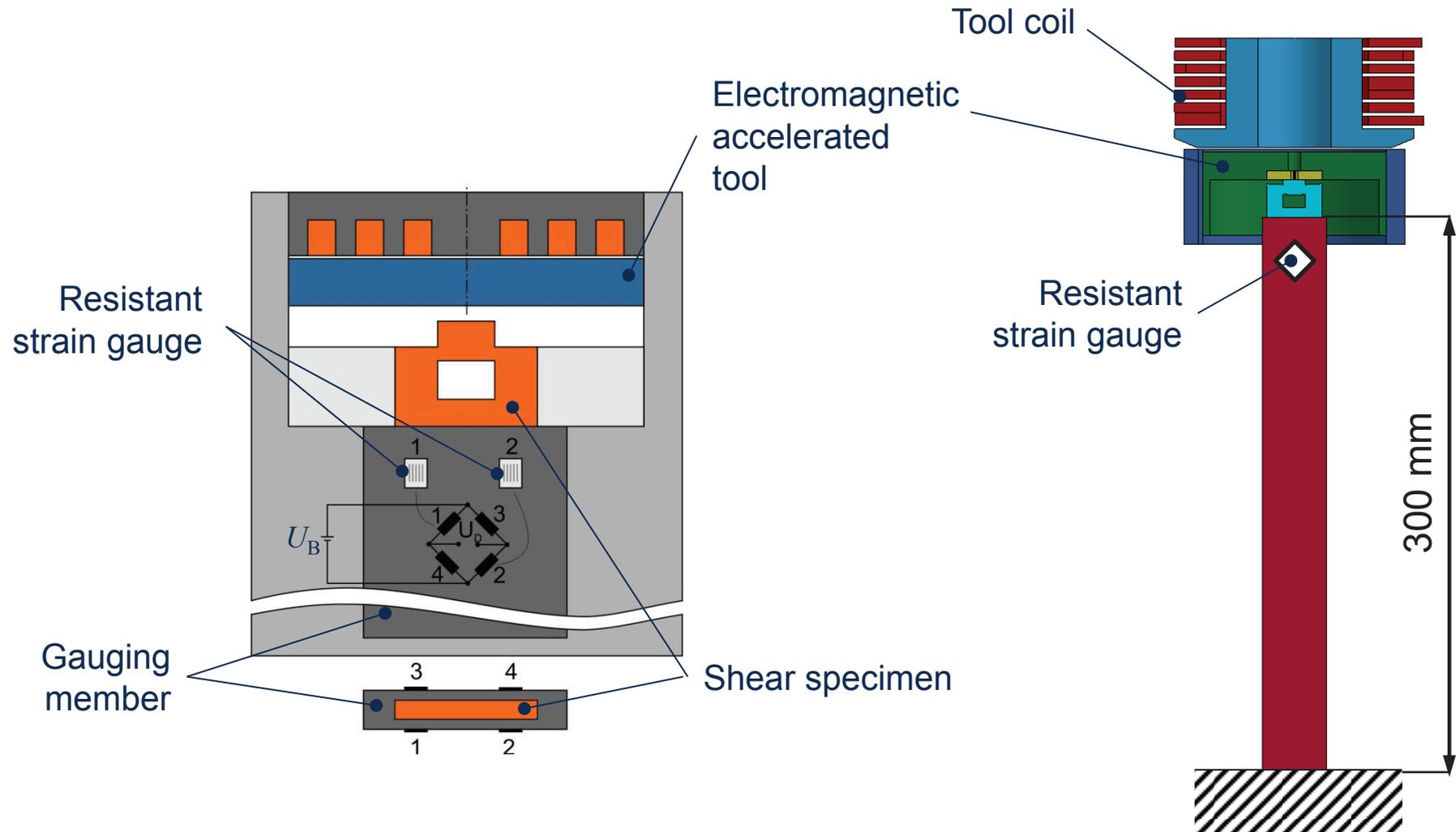




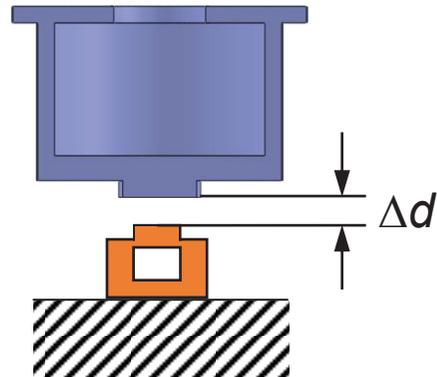
► Advantage: high sampling rate > 1MHz

Measurement Principle – Displacement Accelerometer vs. shadowing principle

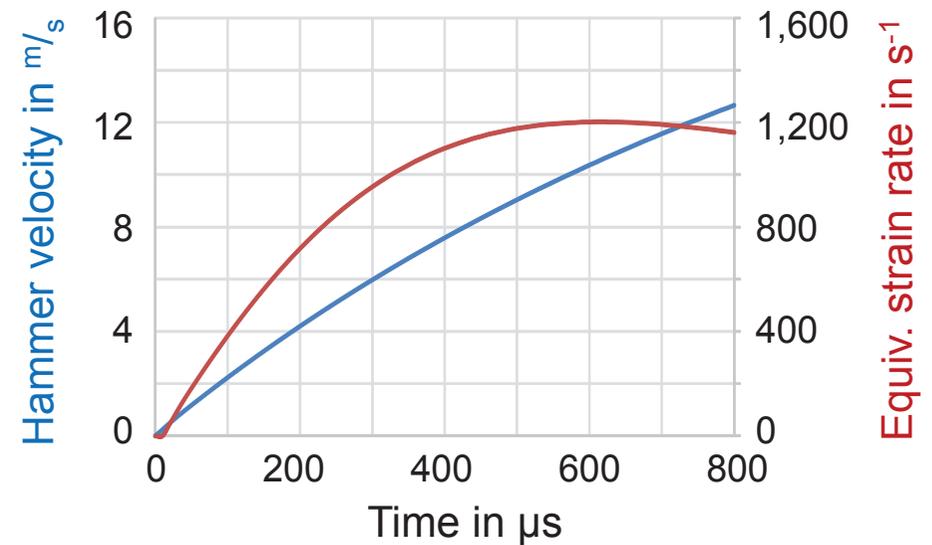
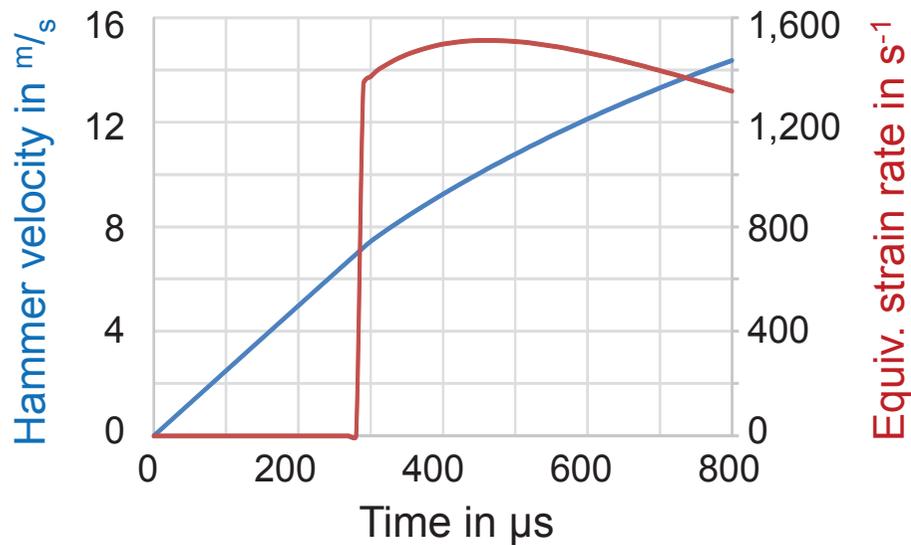
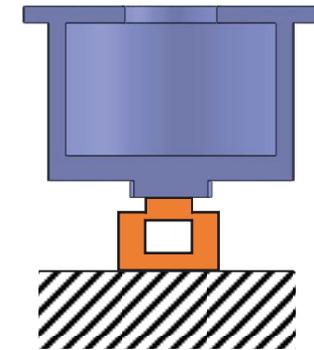




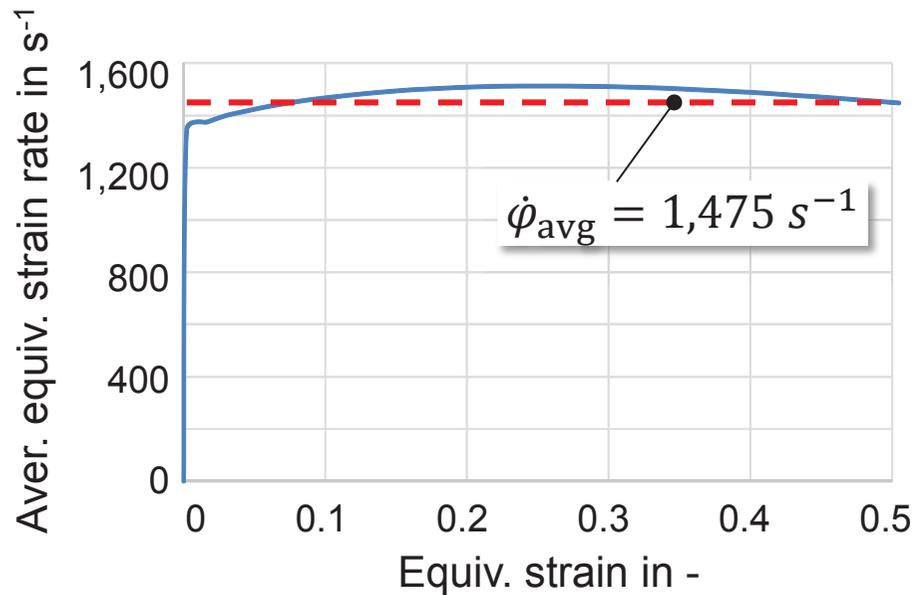
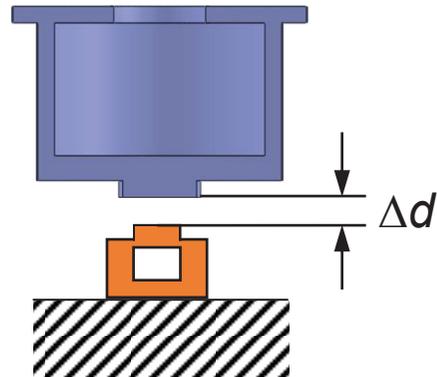
Mode 1: $\Delta d > 0$



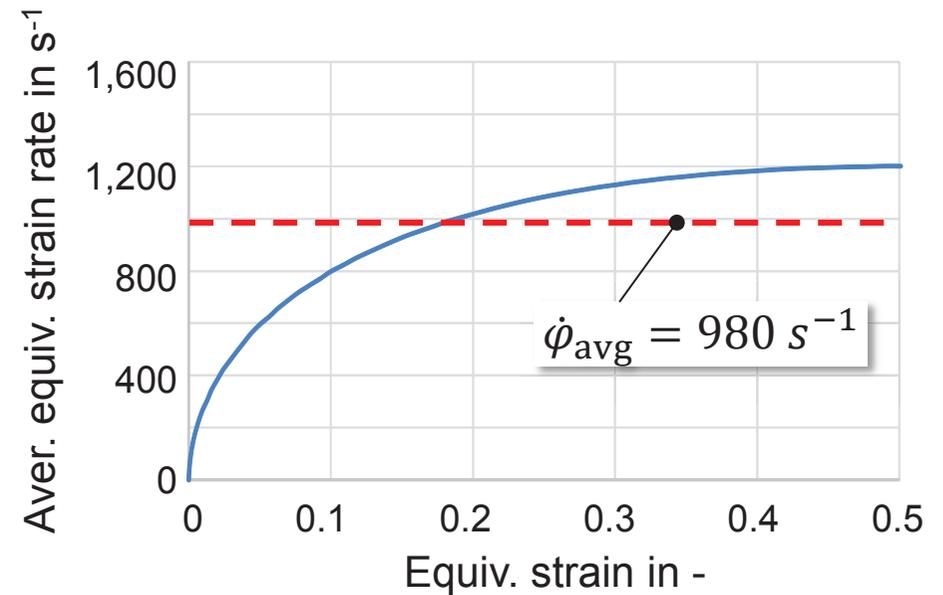
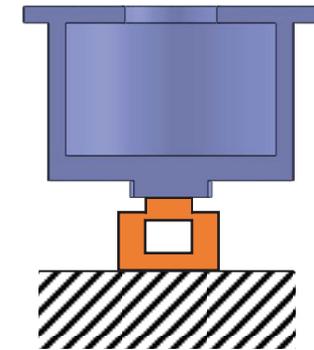
Mode 2: $\Delta d = 0$



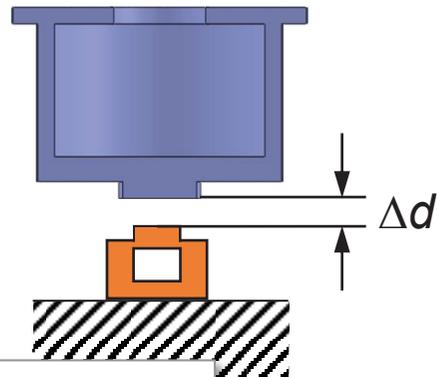
Mode 1: $\Delta d > 0$



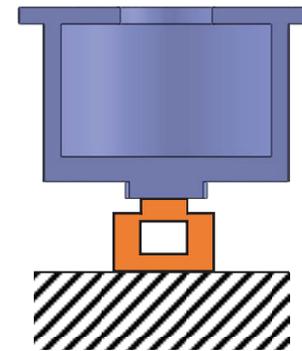
Mode 2: $\Delta d = 0$



Mode 1: $\Delta d > 0$

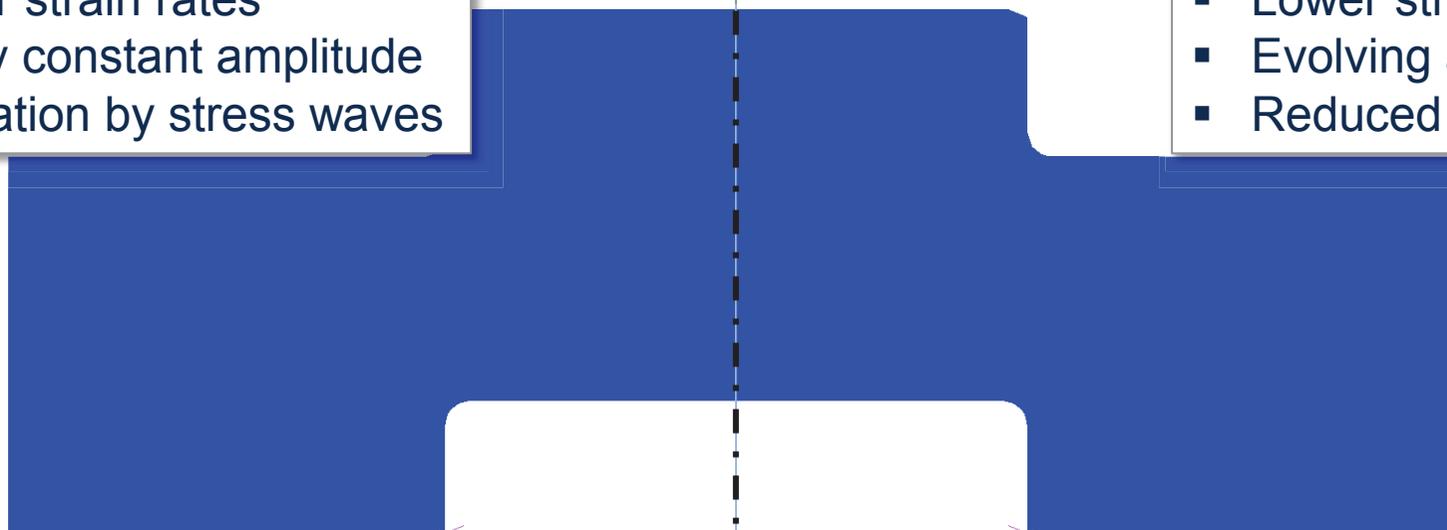


Mode 2: $\Delta d = 0$

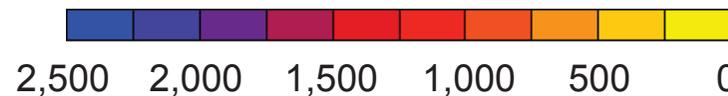


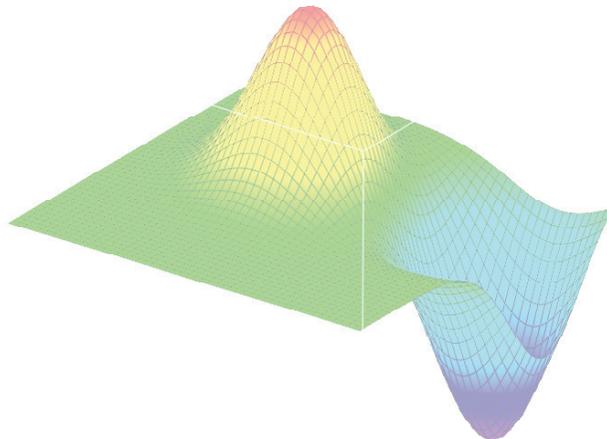
- Higher strain rates
- Nearly constant amplitude
- Oscillation by stress waves

- Lower strain rates
- Evolving amplitude
- Reduced oscillation



Equiv. strain rate in s^{-1}





$$\sigma = (A + B \cdot \varepsilon^n)(1 + C \cdot \ln \dot{\varepsilon} / \dot{\varepsilon}_0)(1 - T^{*m})$$

Input data

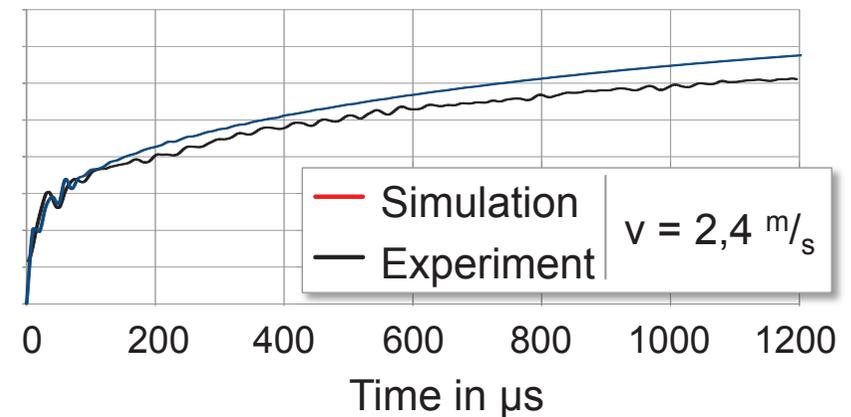
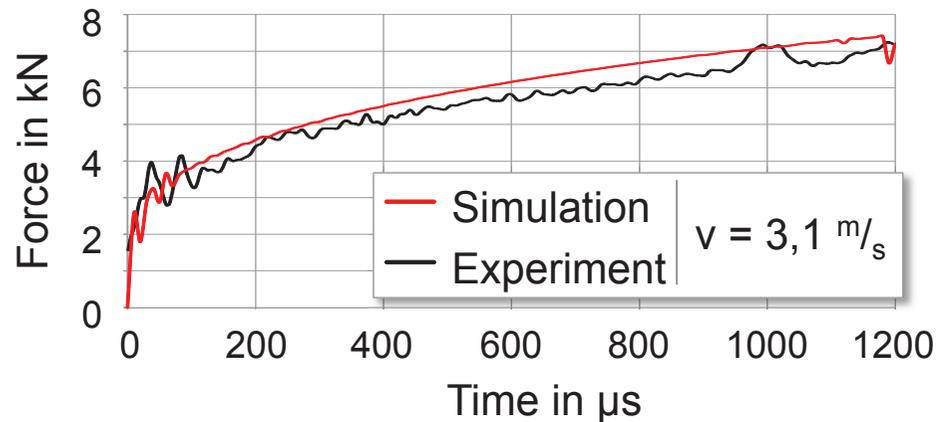
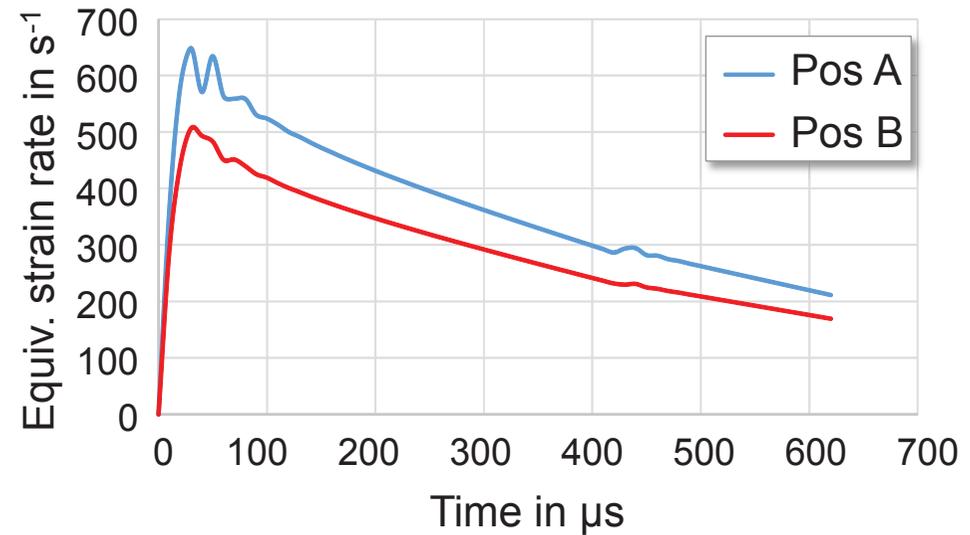
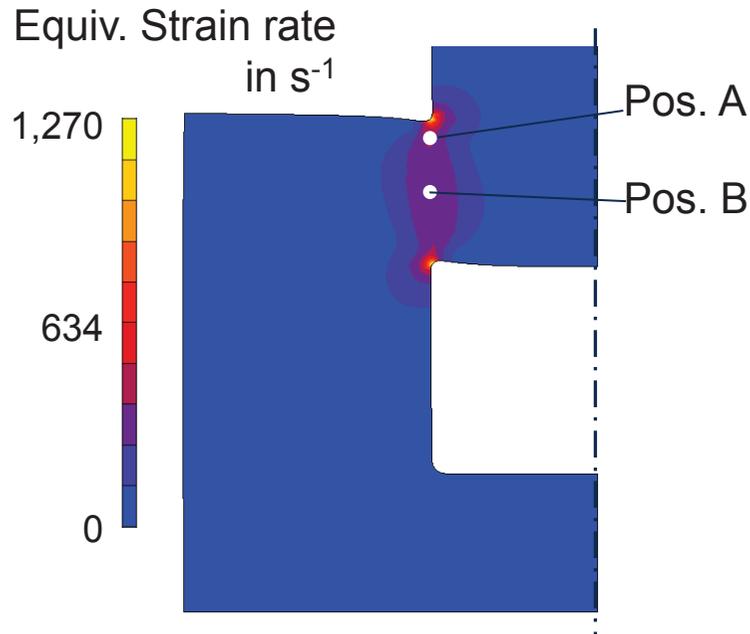
- Coil current vs. time (EMF machine)
- Material Law (Johnson Cook)
- Material Parameter
- Effective Damage Evolution Law
- Damage parameter



Identified parameter

Experimental data

- Displacement vs. time
- Strain vs. time
- Time at material failure



- Two experimental setups for high strain rate testing procedure
- Choice between acceleration and impact mode possible
- Adjustment of strain rate evolution during test
- Identification procedure by inverse approach



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