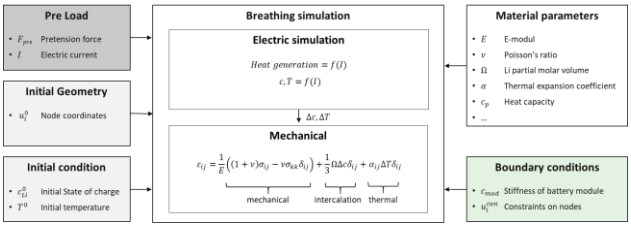
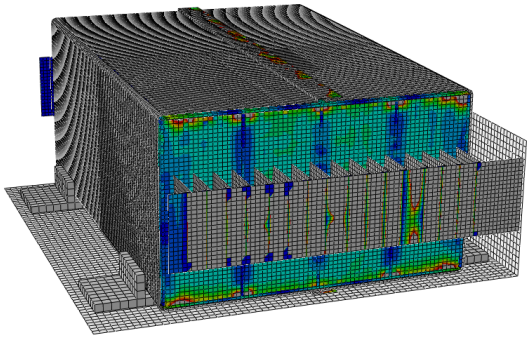
Vehicle Safety Insitute

Numerical modeling of breathing mechanisms of Li-Ion batteries

Background

Li-Ion batteries in (hybrid) electric vehicles change thickness during charging and discharging due to intercalation of Li-Ions ("**breathing**"). In a battery module, the constrained battery cells cause an increase in **pretension force** and asymmetric **pressure distribution** over the cell body. The changes in mechanical behavior of battery cells may affect crashworthiness of a battery module and should therefore be modelled within a numerical simulation software (Abaqus).





Source: VSI / TU Graz

Your goal in this thesis is to describe the mechanical behavior of battery cells considering the **breathing mechanism** by developing a **numerical model** and an adequate **material description**.

Tasks

- **Get familiar** with the subject breathing of Li-Ion batteries.
- **Understand** the connection of mechanical behavior of battery cells and breathing.
- **Develop** numerical models, plan and conduct validation experiments.
- **Implement your ideas** by extending existing mechanical battery models.
- **Cooperate** with renowned industry partners.

Literature

- Werner et al. (2021): *A multi-field model for charging and discharging of lithium-ion battery electrodes.* In: Continuum Mech. Thermodyn. 33 (3), S. 661–685. DOI: 10.1007/s00161-020-00943-8.
- Zhao et al. (2019): *A review on modeling of electro-chemo-mechanics in lithium-ion batteries*. In: Journal of Power Sources 413 (11), S. 259–283. DOI: 10.1016/j.jpowsour.2018.12.011.

Recommended as

Master's thesis for Mechanical Engineers

Organizational

- **Start**: anytime
- **Scholarship**: min. € 2.500,- for successful completion of thesis
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