Cutting edge laser shock peening

Intertwining industrial practice and academic simulation

PRODUCTIVE SECTOR: Mechanics and Mechatronics

PROBLEM DESCRIPTION

Use numerical simulation to improve laser shock peening (LSP) treatment of a cutting edge. Ultimately, improve the cutting edge lifespan.

CHALLENGES AND GOALS

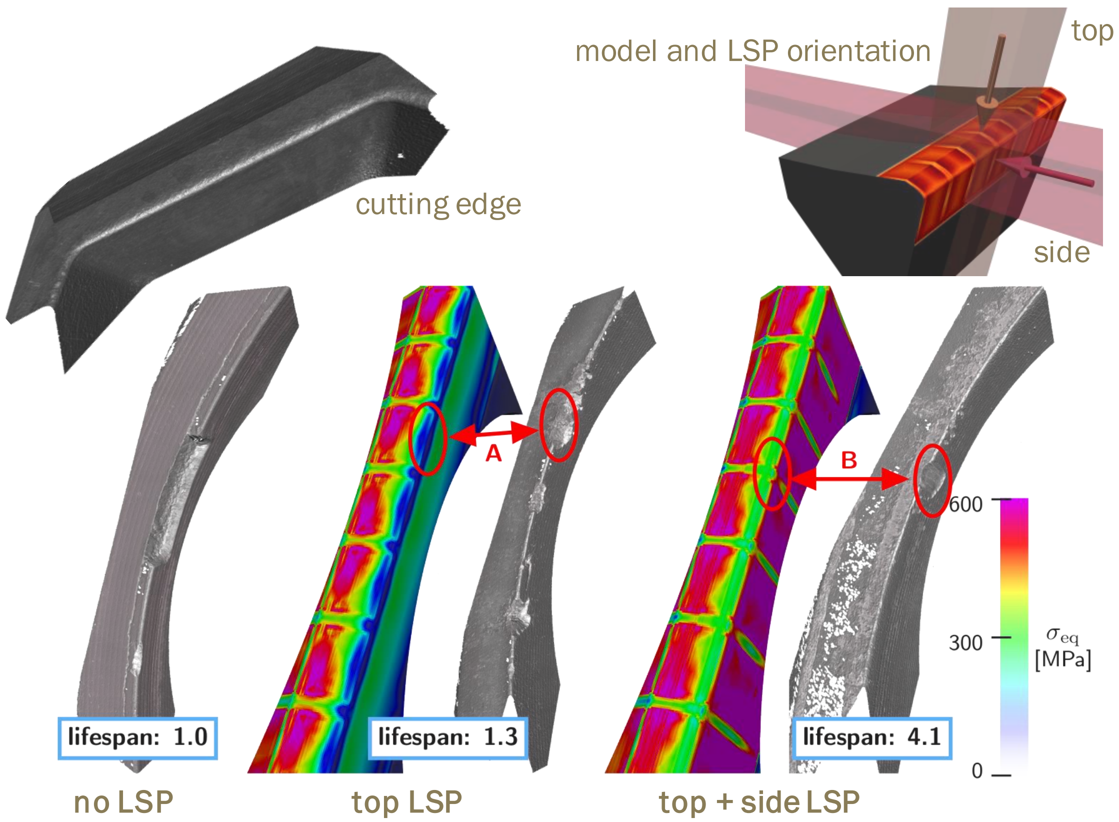
- Develop a simulation framework for LSP usable for real-life geometries and industrial applications.
- Be able to solve elasto-plastic shockwave propagation on imperfect meshes.
- Explain observed behavior of treated samples.

MATHEMATICAL AND COMPUTATIONAL METHODS

Solved physics: Elasto-plastic shockwave propagation hardening treated material.

Mathematical modeling: Partial Differential Equations solved via Finite Volume Method

Implementation: pyLSP (own code), OpenFOAM (open-source code)



Studied cutting edge; its model with examined LSP orientations; and comparison of cutting edge fatigue wear with simulated distribution of LSP-induced compressive residual stresses

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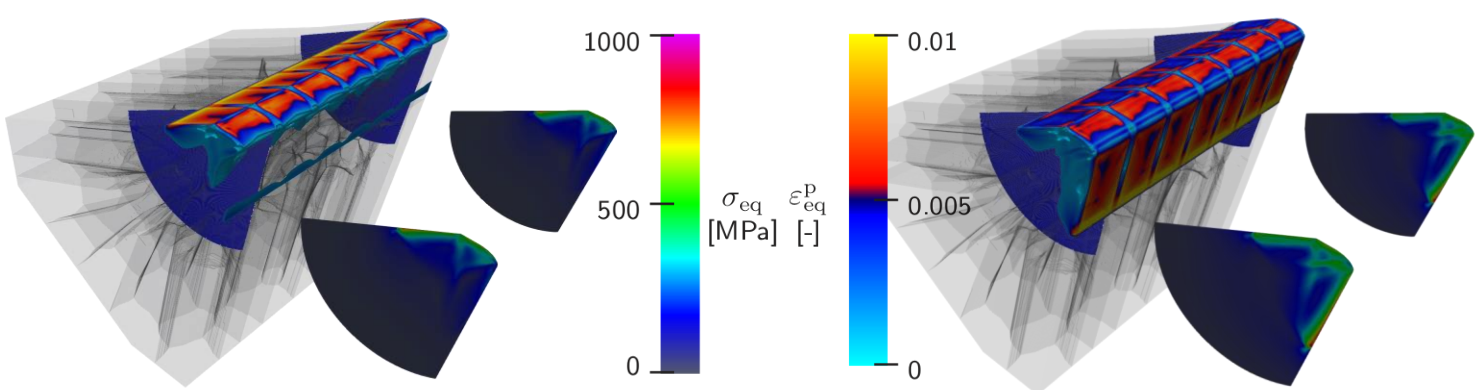
Results and Benefits

- Free simulation framework for LSP on industrial parts is available
- LSP treatment increasing cutting edge lifespan by 400 % was devised
- Better LSP results explainability was achieved
- LSP optimization for specific part and material is possible

Numerical **simulation allows for** part- and material-**tailored Laser Shock Peening,** leading to an **increase in** LSP **applicability and competitiveness.**



Induced plastic deformation and in-material compressive residual stresses after top cutting edge LSP

Induced plastic deformation and in-material compressive residual stresses after top and side cutting edge LSP

Mechanics and Mechatronics

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