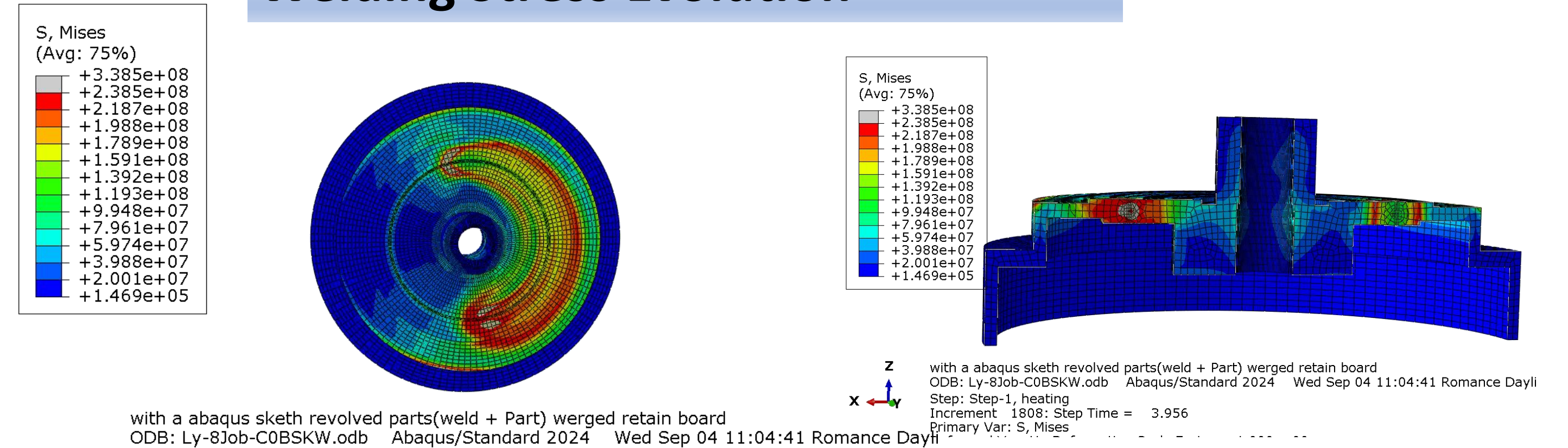


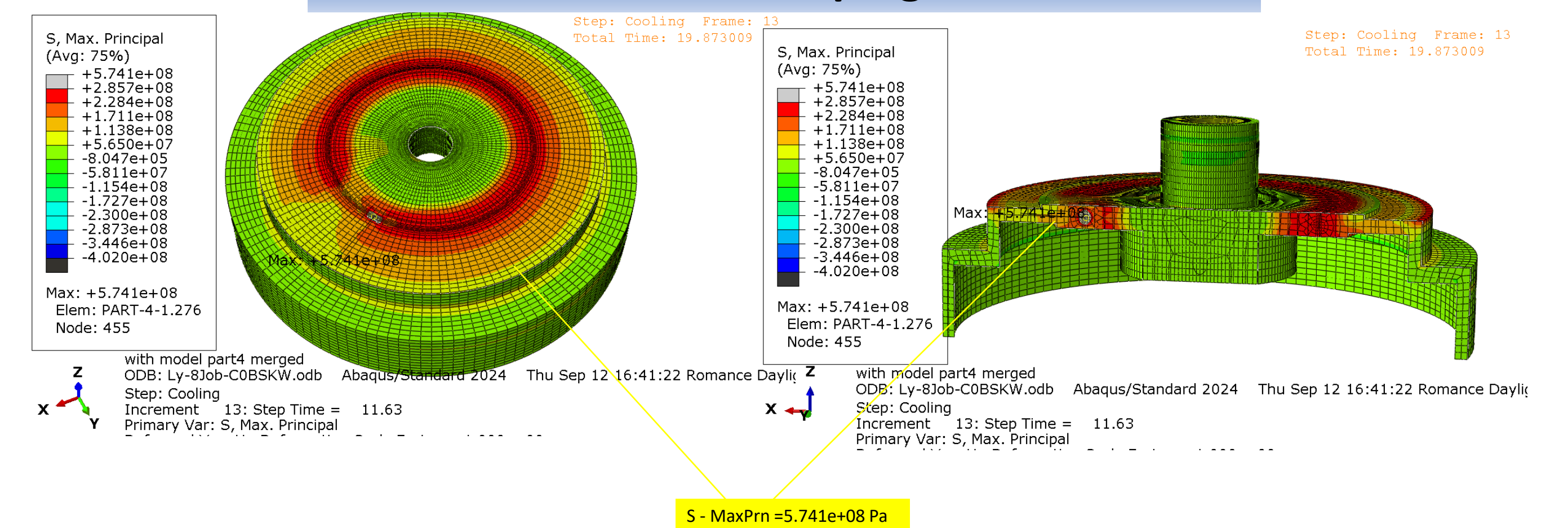
Introduction

The poster presents simulation results of a steel gearbox manufactured using laser beam welding. The complete welding process simulation was performed based on previously studied models, developed subroutines, and the Abaqus explicit solver. The weld residual stress results show the actual fracture location corresponding to the highest value.

Welding Stress Evolution



Residual Stresses developing



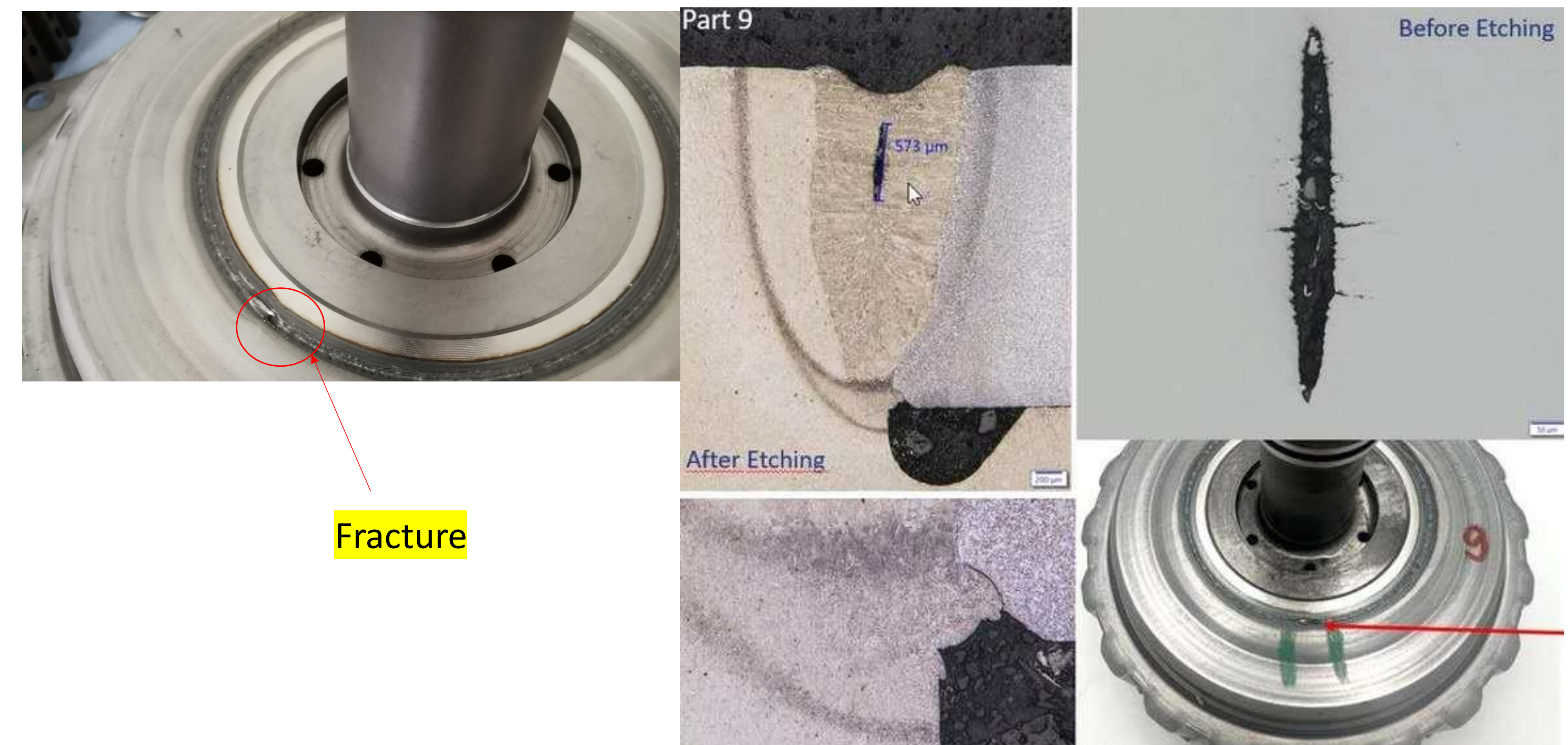
SIMULATION STEPS

1. Build 3D model of the gear box with welding beam specified. (Fig 1 a, b)
2. Input parameters of welding or WAAM processing in Dflux subroutine—waam_s.for
3. The heat source shape.
4. Element activating and step interacting_Tes_stepInt.py

1. Calculate heat rate and cooling rate by python script (heatrate.py, Crates.py).
2. Input chemical composition and metallurgy-phase analysis. (batch.bat file), **ABAMAIN**.
3. Coupled phase volume fraction in UMAT subroutine → coupled T-M-M

TM-FE in CAE
GEO-BC-INT

Abaqus Odb
NT
Fy1-Fy6,
HV, UTS,
Stresses, deformation



Conclusions

- We have developed a numerical tool for virtual experiments in GAW, laser welding, and WAAM processes.
- This tool includes thermal, metallurgical phase structure and hardness, and mechanical models. Simulation results show good agreement with practical applications.
- We conducted a series of numerical simulations on a scaled-down model of WAAM sheet metal to collect data for training an artificial neural network (ANN).
- In the future, we will use the ANN tool to design an inverse model of low-carbon alloy steel, realizing the mapping relationship between "material properties → phase volume fraction → WAAM process parameters," thereby constructing a simple WAAM process strategy tool.

Temperature and Stress Evolution

The steel grades used are
shaft: 20MnCr5 (+QT)
basket: S355MC
weld: mixture (0,8mm wide, 2.8 mm deep)
Welding time: 7.54 seconds + 0.7 seconds over root, stop.
Q = 1500~2000

