

YOSHIKAWA LAB.

Advanced Design and Manufacturing of CFRP Tank by High Performance Computing



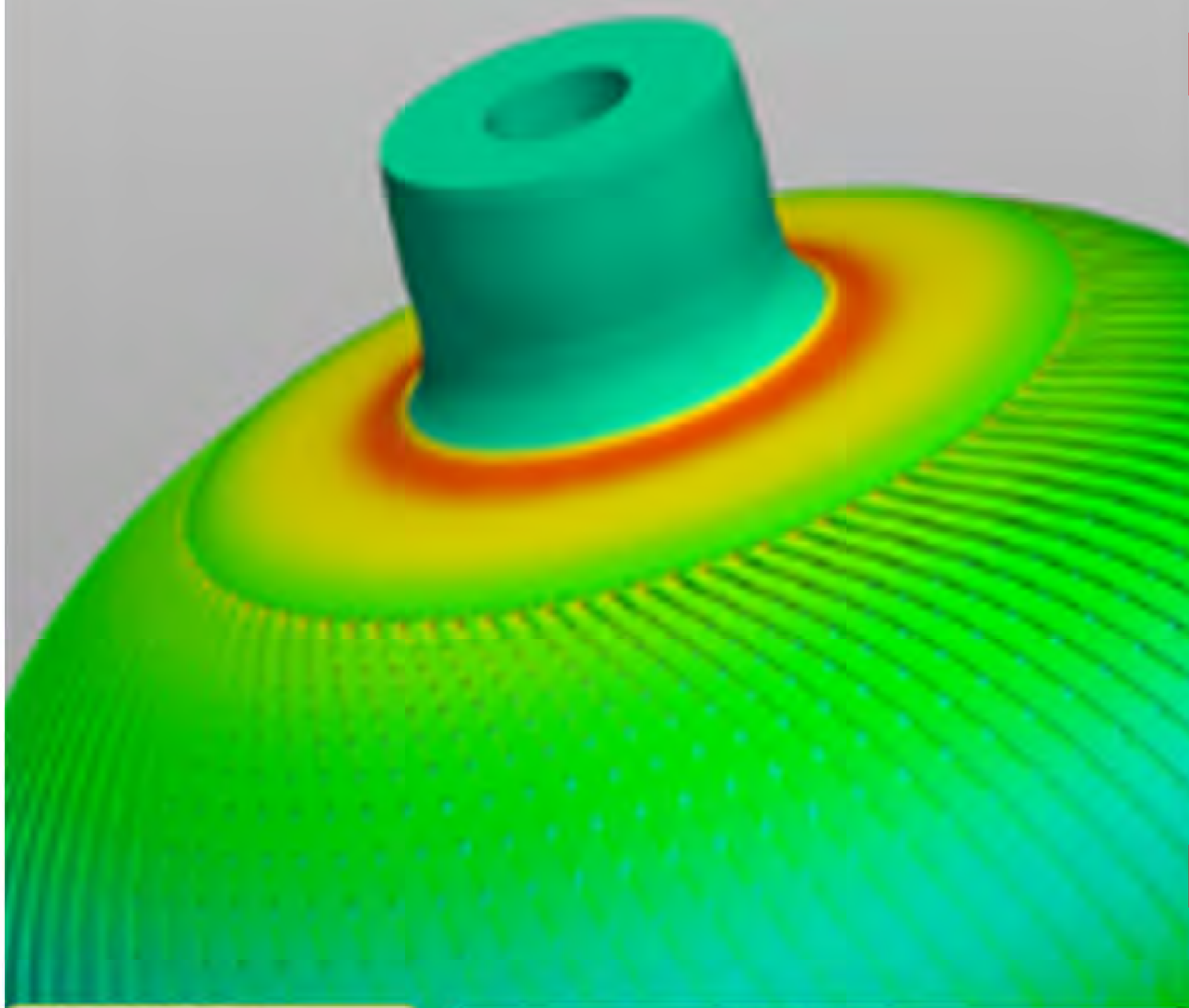
Center for Research on Innovative Simulation Software

Multi-scale Solid Mechanics

Department of Mechanical Engineering, Graduate School of Engineering

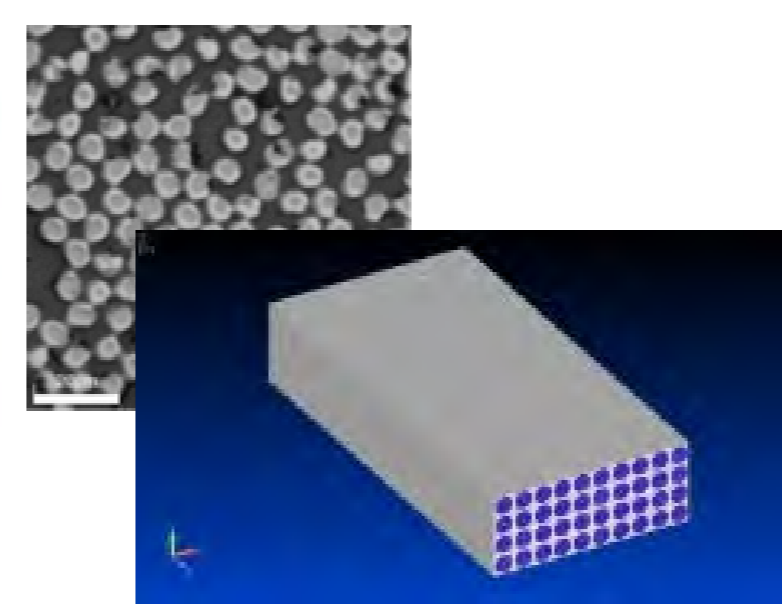
<http://www.young.iis.u-tokyo.ac.jp>

FrontCOMP
Advanced Simulation Software
to Support Design and Production
of CFRP Pressure Vessels



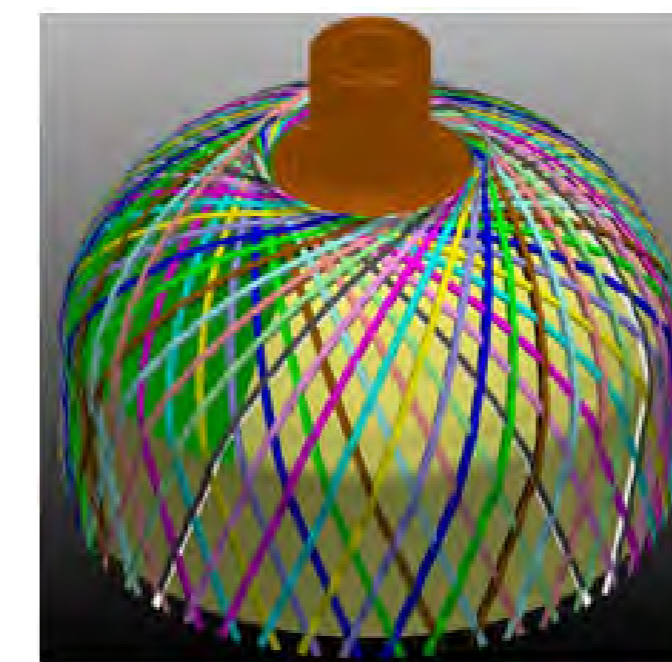
Multi-scale Modeling of CFRP

Micro-scale



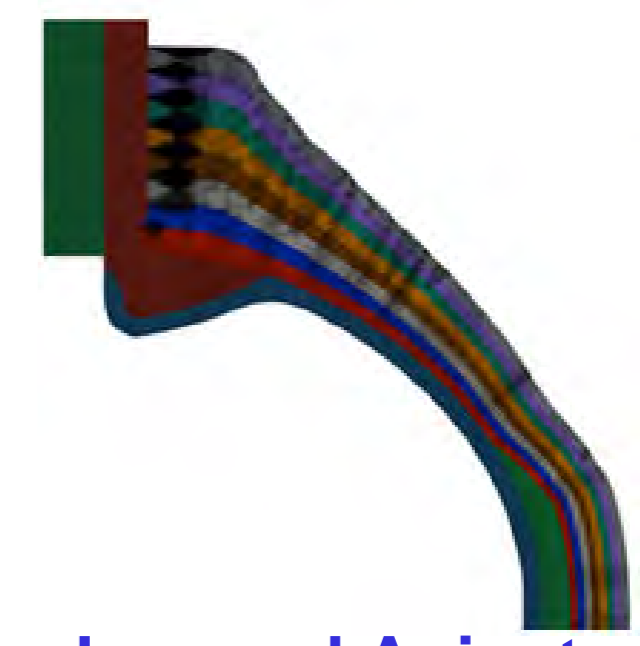
Carbon Fiber/Resin

Meso-scale



Carbon Fiber Bundle/Resin

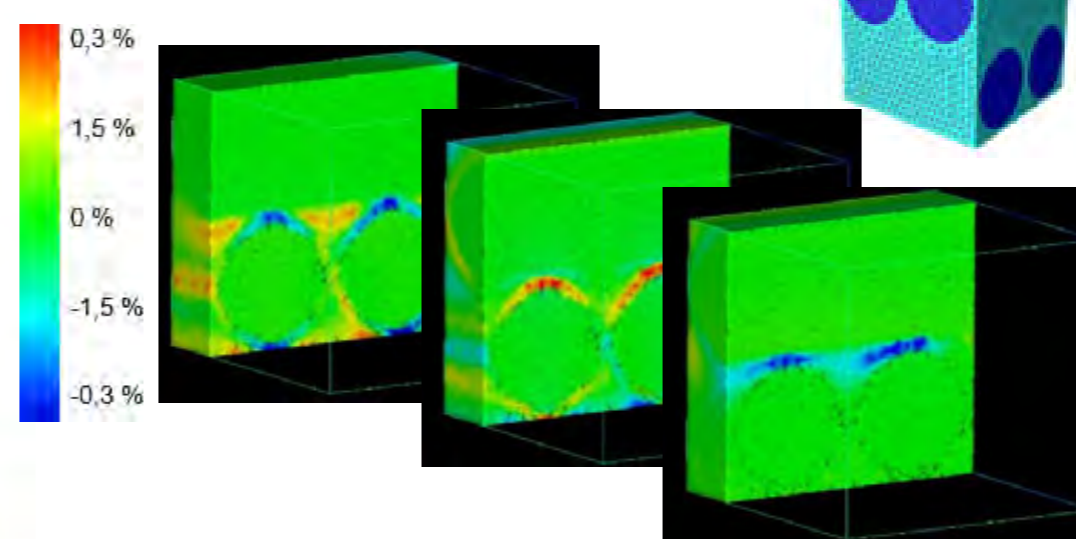
Macro-scale



Layered Anisotropic Continuum

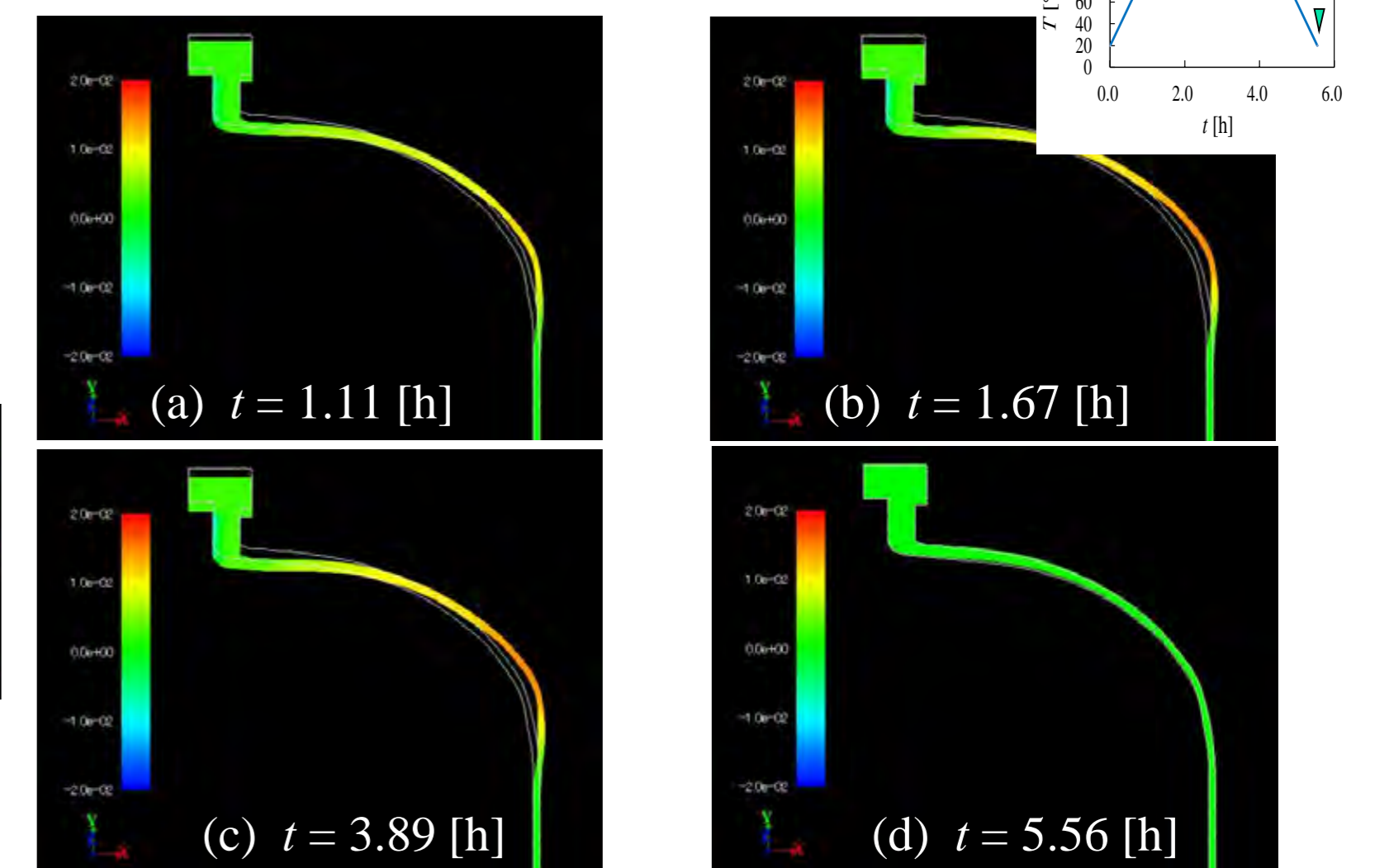
Curing Process Simulation

Two-scale Simulation



(1) ϵ_{11} (2) ϵ_{22} (3) ϵ_{33}

Macro-scale Material Property Identified by Micro-model

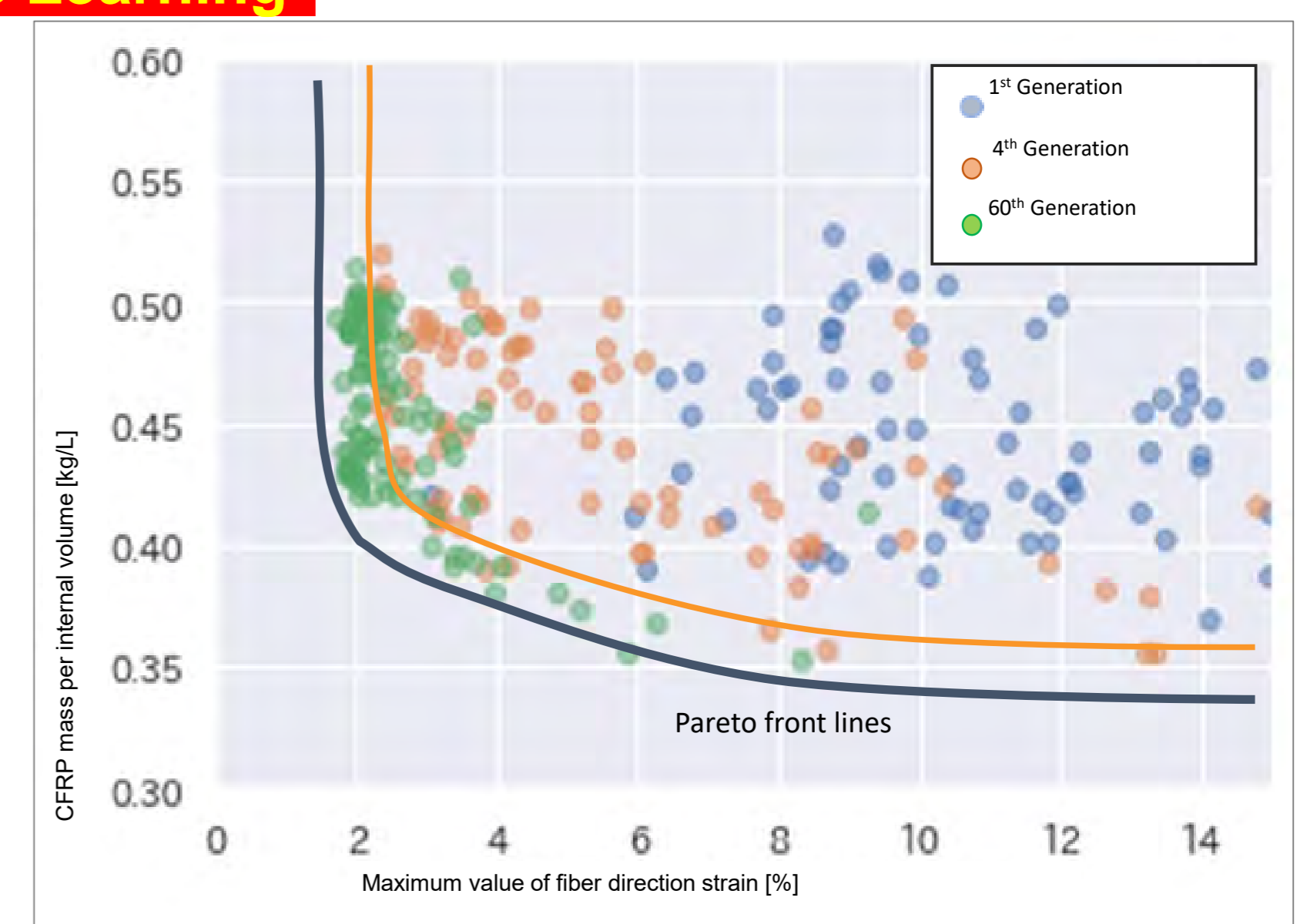
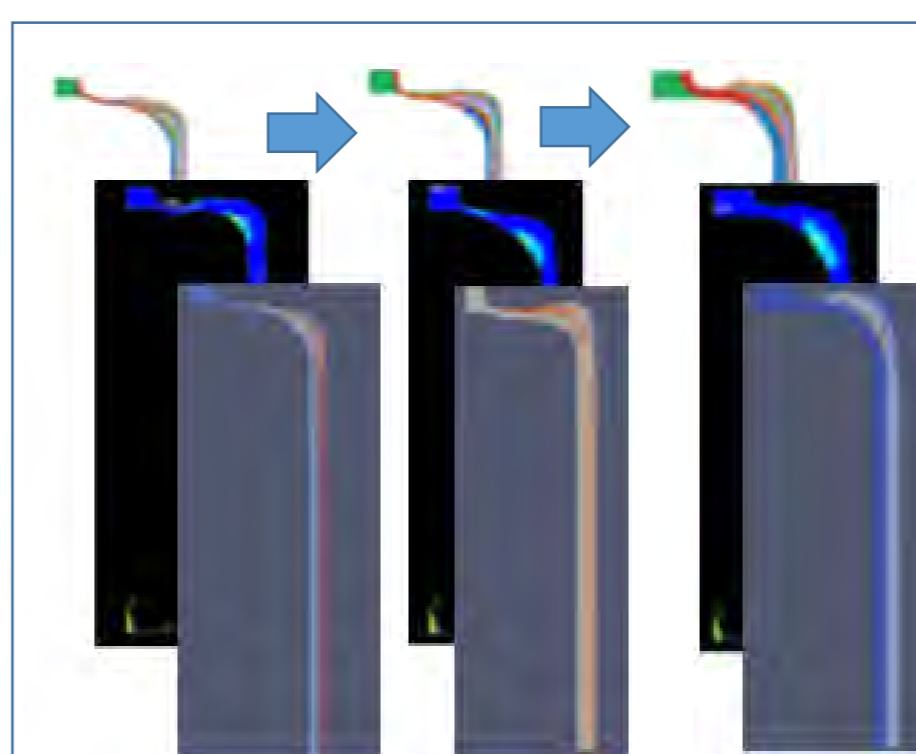


Hoop Strain: ϵ_{θ} and Deformation

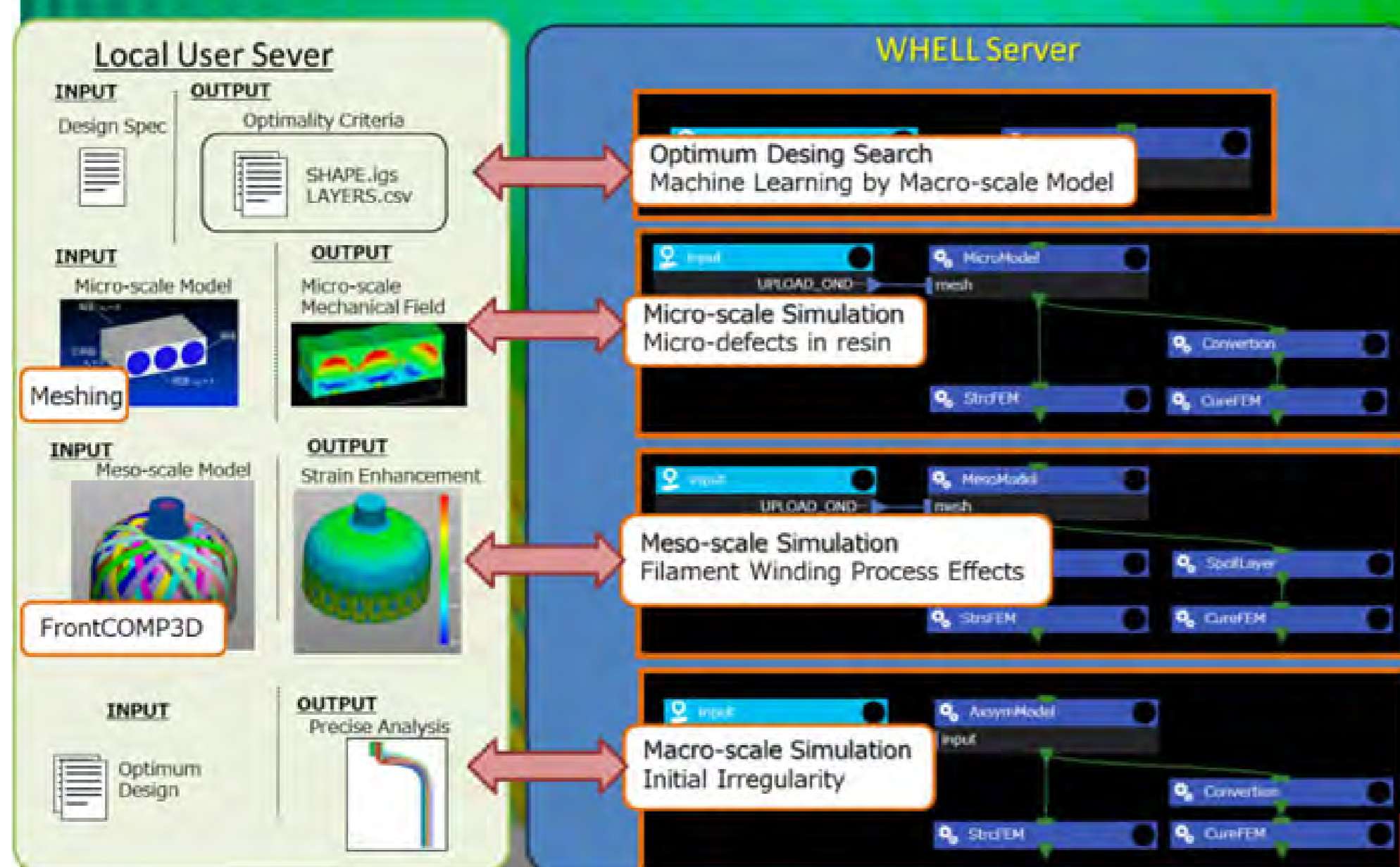
Curing Simulation by Macro-model

Optimum Design by Machine Learning

Improved Macro-model
• Material Strength Model by Meso-model



Optimum Design Search Process



Digital Data Processor for FW Pressure Vessel

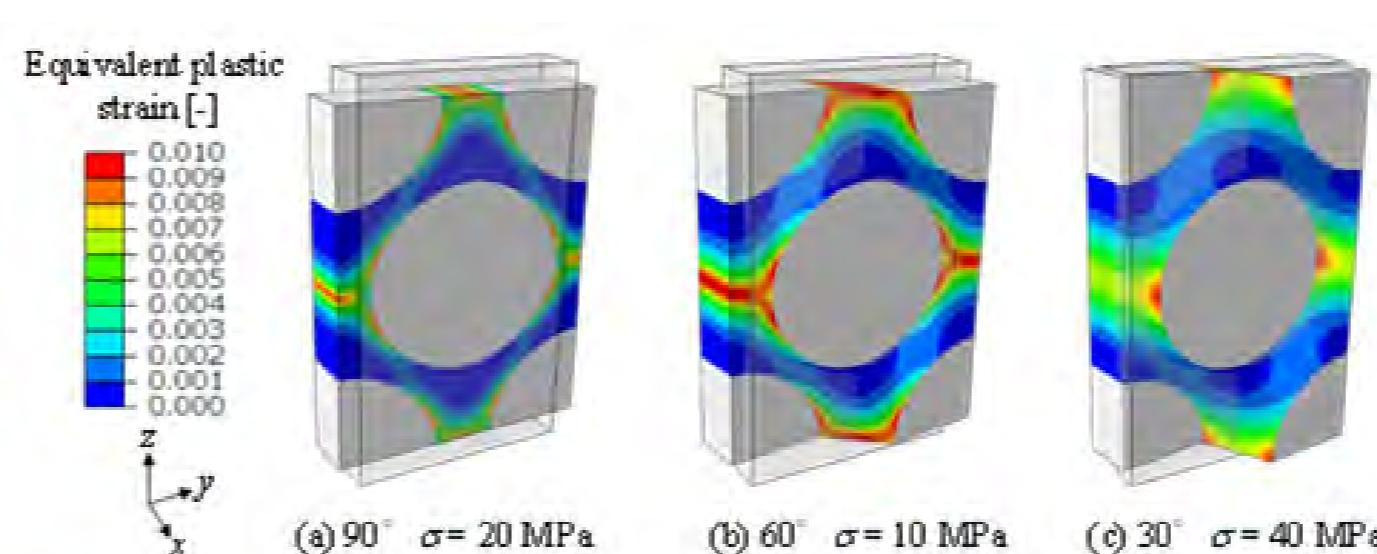
- FrontCOMP_tank: Axisymmetric continuum model
- FrontCOMP_FW: Single-FW meso-model
- FrontCOMP_FW_multi: Multi-FW meso-model
- FrontCOMP_FW_shell: Multi-FW meso-model by shell
- FrontCOMP_wind_multi: CAM data for Multi-FW

Forming Simulation of CFRP

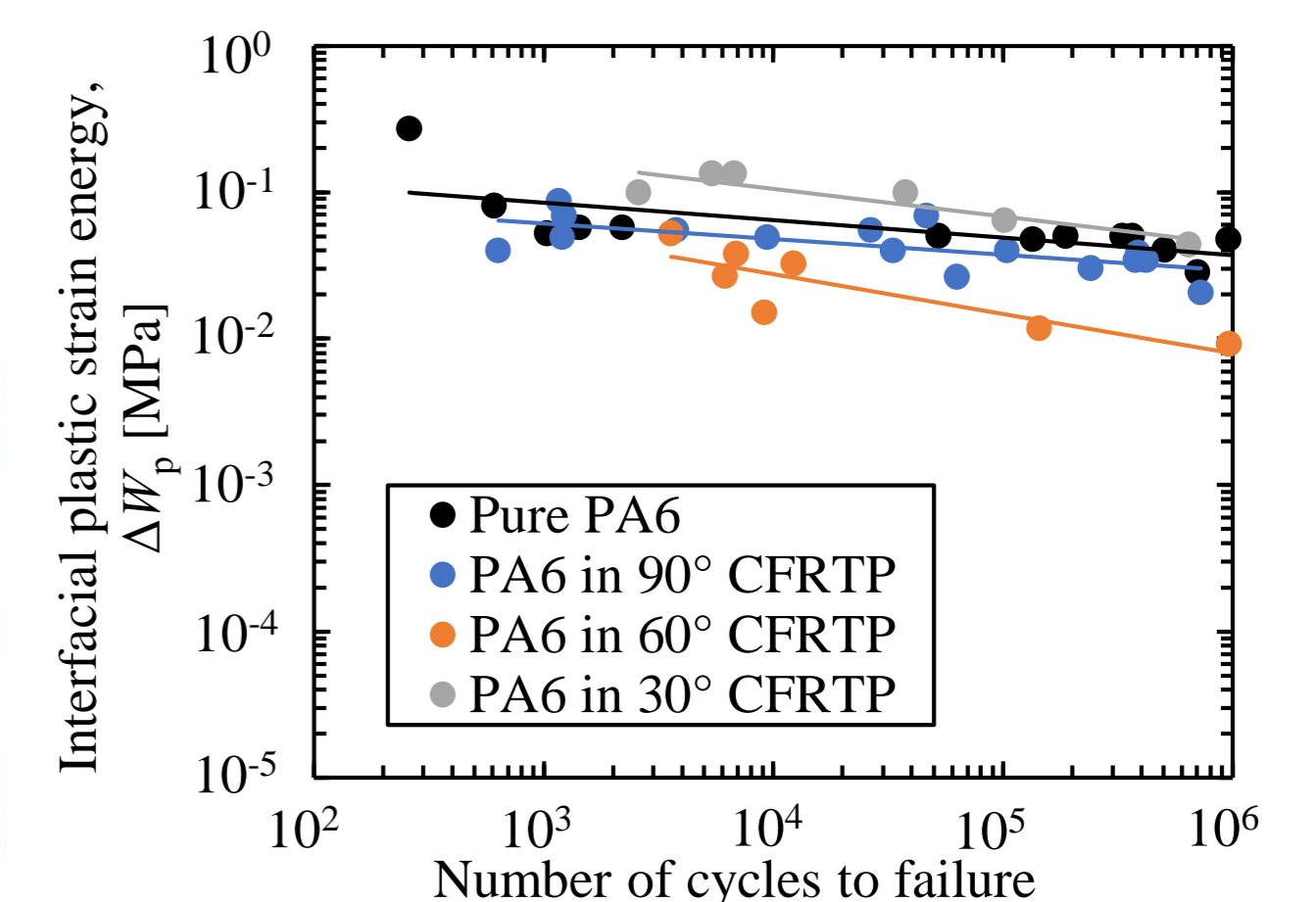
- FrontCOMP_cure: Thermoset CFRP
- FrontCOMP_TP: Thermoplastic CFRP

Fatigue Strength Model

Micro-scale Material Strength
• Fatigue Life Governed by Resin



Resin Stress by Micro-model



Fatigue Life Prediction of Specimen

