

Takemoto LAB.

[Optimal Design of Hydrogen Tank by Machine Learning]

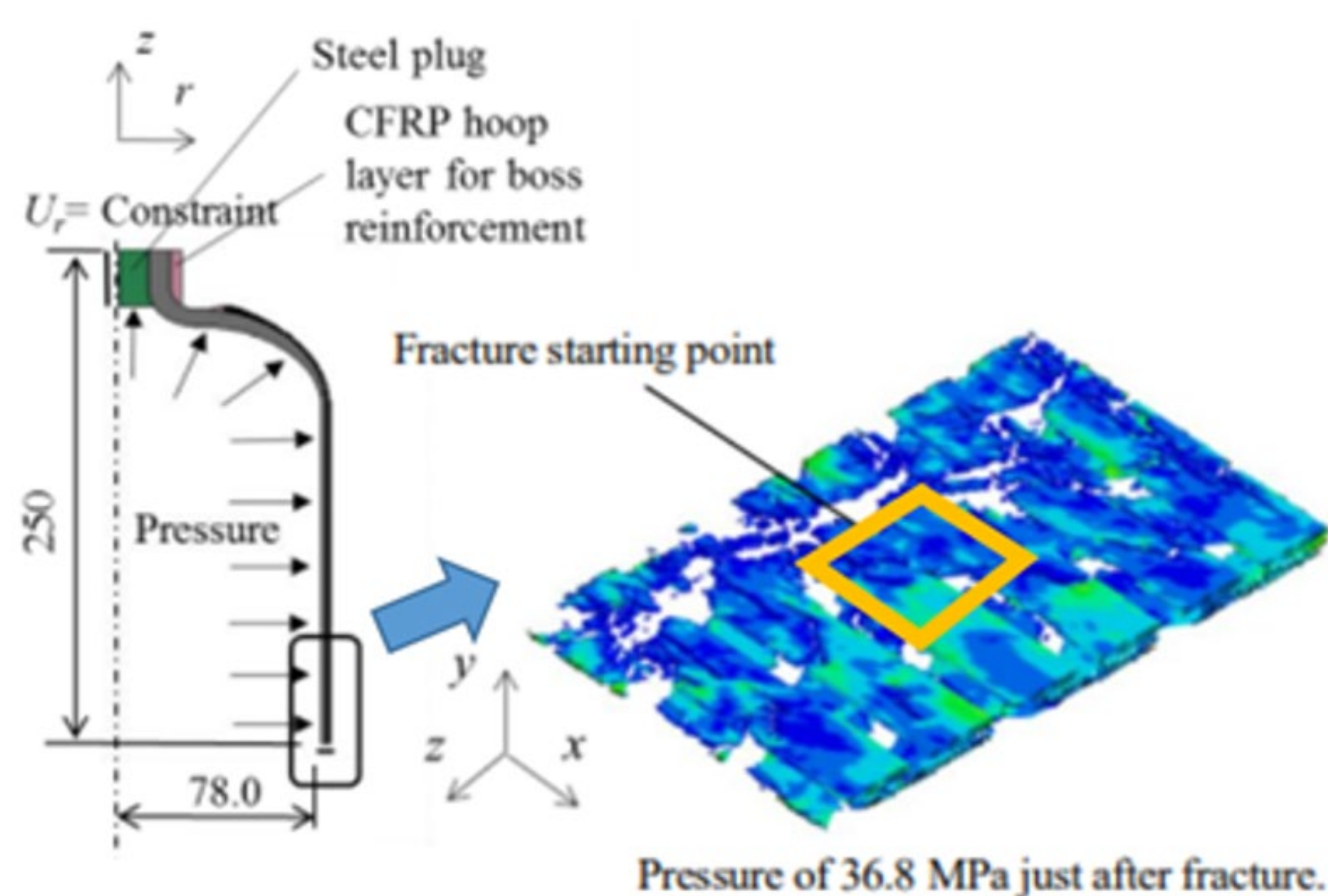


Department of Fundamental Engineering

AI Design Engineering

Carbon fiber reinforced plastic (CFRP) is used for the hydrogen storage tank, which is indispensable for a hydrogen society aiming at de-carbonization, because it is lightweight and can withstand high pressure. As a result, the structure of the tank is complicated and there are large number of design parameters, so the tank test, which requires a huge amount of period and cost, and the try and error design based on it have made it extremely expensive. In this research, we will build a design optimization AI that easily obtains the optimum design parameters that are inexpensive and lightweight while satisfying the tank design requirements by inverse analysis using a machine learning model.

- Creation of machine learning data by mesoscale model simulation that reproduces the destruction phenomenon of CFRP on the mesoscale.
- Development of a machine learning module that rationally searches for the optimum solution in the shortest time.
- The optimal solution obtained by design optimization AI is demonstrated by theory and experiment by mesoscale model simulation and tank rupture test.



Mesoscale model simulation of high pressure hydrogen tank

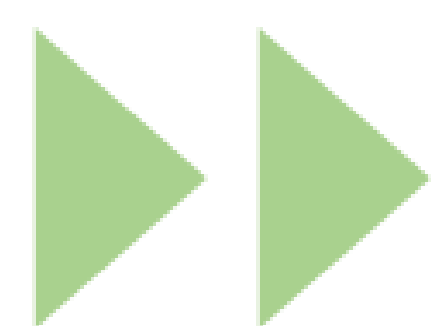


Tank rupture test

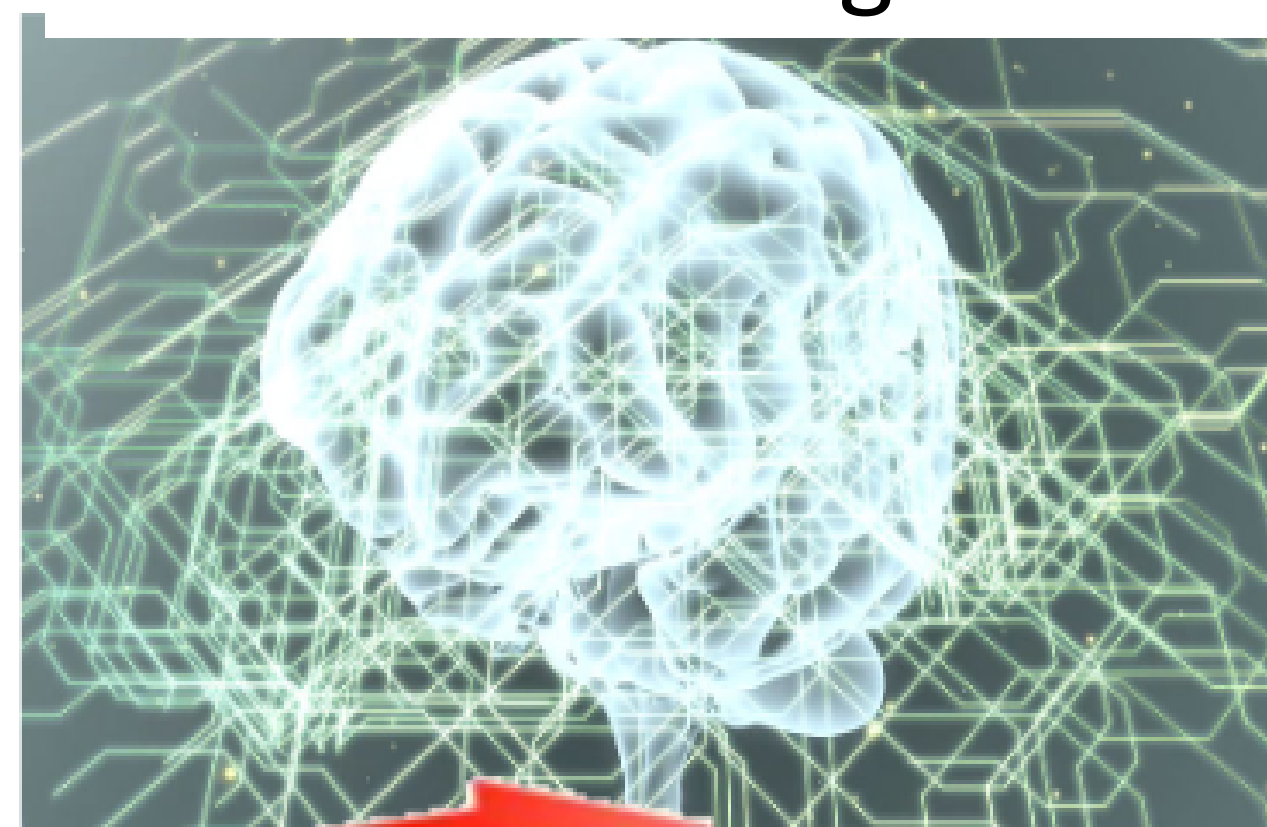
Design optimization AI

Design requirements

- Carbon fiber type
- Resin type
- Burst pressure
- Volume
- Space



Machine learning model



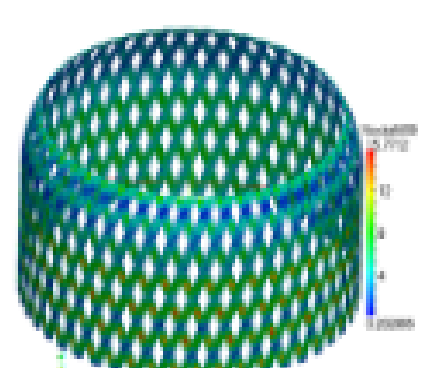
Optimal design

- Shape
- Dimension
- CFRP laminate

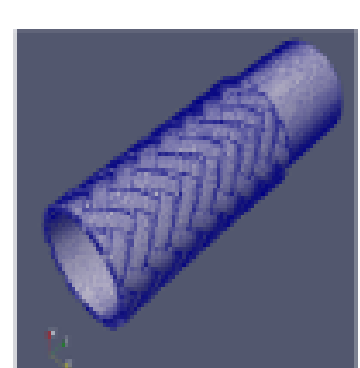
FrontCOMP

Creation for machine learning data by mesoscale simulation

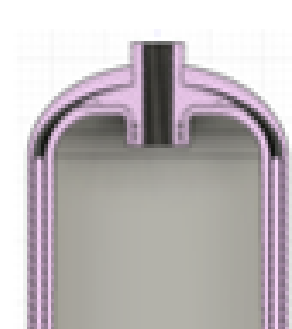
Design parameters



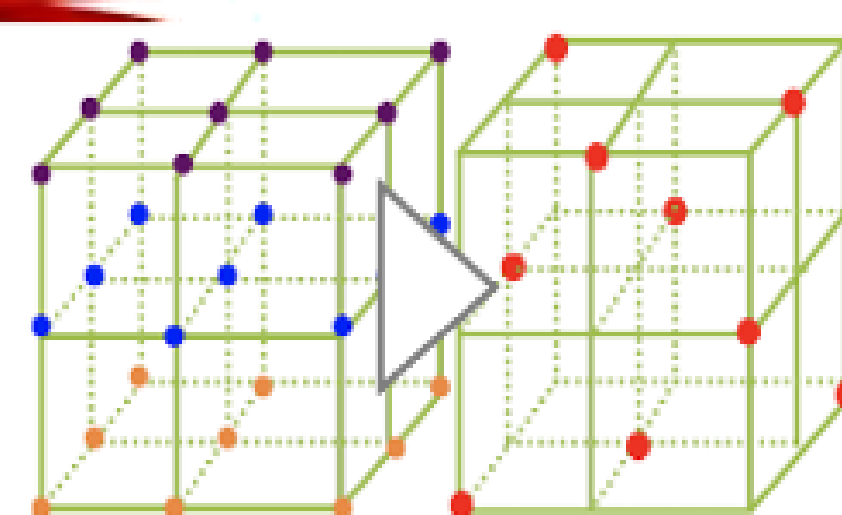
Filament winding



Braiding

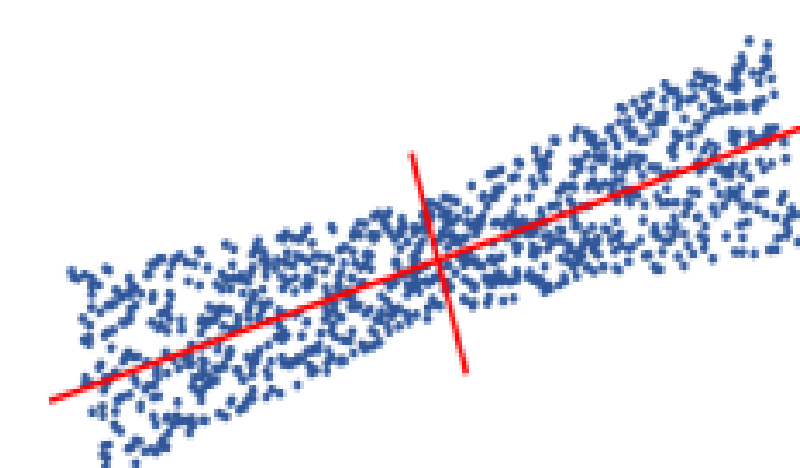


Plug design

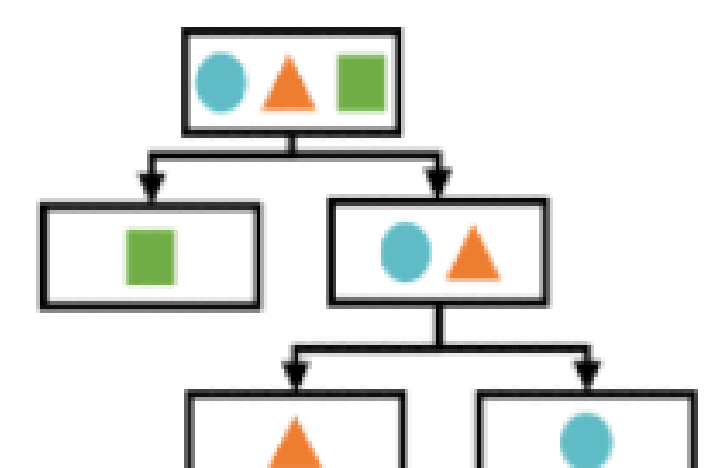


Design parameters setting by discrete optimization

Machine learning module



Principal component analysis



Machine learning algorithm

Model construction by machine learning algorithm