Enhancement of strength of structural materials meets the requirements in many applications, and especially contributes to the improvement of the resource and energy problem from the body-in-white weight reduction of automobiles. To enhance deformability of structural materials without losing strength, our lab aims to develop new structural materials with enhanced performance by characterizing defects, deformations, and fractures in structural metals and alloys with a help of data-driven material science.

1) In-situ observation of local deformation and phase transformation kinetics of metals

In-situ measurement of surface relief induced in low-carb steel by digital holographic microscopy

2) Estimation of internal properties of Al alloys from EBSD data and phase-field model using data assimilation

Comparison of phase-field simulation results and and experimental observations

3) Unsupervised machine learning applied for the characterization of steel microstructures

Unsupervised machine learning models are applied to characterize the constituent microstructures of steels, such as ferrite side plate, bainite, and martensite, from optical micrographs. It has been demonstrated that efficient characterization can be performed by the combination of CNN and other machine learning algorithms.

4) Identification of phase transformation kinetics using sparse modeling

A Bayesian approach has been applied for clarifying the best kinetic model explaining transformation kinetics and mechanical properties of low-carb steels under different continuous cooling conditions only from experimental and simulation data. It is shown that this method clarifies the underlining physics efficiently without intensive metallographic observations.