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# [Multiscale Modeling Strategy]



Carbon fiber-reinforced plastic (CFRP) composites are widely used in engineering products including aircraft. CFRP has a characteristic hierarchy since it consists of fibers with micron-scale diameters and matrix. Therefore, multiscale simulations are essential for design and reliability of the CFRP products.

### [Multidisciplinary Design Optimization of Composite Aircraft Wing]



The application of CFRP to aircraft, such as the B787, has been expanding rapidly in recent years. In this study, the Multidisciplinary Design Optimization (MDO) method coupled with fluid and structural analysis is proposed for the optimum design of the shape and internal structure of composite aircraft wings.



Thermoset resin, which is commonly used as a matrix in CFRP, consists of a base resin and a curing agent, which form crosslinking networks via chemical reactions. This study analyzes the curing process of thermoset resins by using molecular dynamics simulation and investigates the curing <u>characteristics and mechanical properties of resins</u>.

# [Airport Surface Traffic Flow Analysis]



The global air traffic is expected to increase in the future, and in order to cope with this, optimization of operations, especially at airports and surrounding airspace, is required. In this study, the characteristics of air traffic flow are obtained from flight data, and based on the results, the dominant factors of air traffic flow on the airport surface of Haneda Airport are clarified by numerical analysis, and the optimal management method is investigated.

#### [Numerical Simulation of Progressive Damage in CFRP]



#### ♦ Crack initiation in CFRP laminate (Fig.1)

Transverse crack is the initial failure of composite structures, and the strain where those cracks are generated is often used in the design criteria. In order to verify the structural reliability, multiscale analysis for the initiation of transverse cracking in cross-ply laminates is conducted using the periodic unit cell (PUC) analysis.

♦ Open-hole compressive (OHC) strength of CFRP laminate (Fig. 2) Open-hole strength is important because CFRP members with holes are riveted in the aircraft body. This study will develop a numerical analysis method that can reproduce the OHC test with high accuracy and contribute to cost reduction related to aircraft certification.