Research on Structure and Composite Material Technologies for Digital Certification

● **Responsible Representative**

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● **Abstract**

The objective of this research is to accurately model manufacturing defects in CFRP laminates and clarify their effects on strength.

● **Reasons and benefits of using JAXA Supercomputer System**

High-performance parallel computing with large memory capacity is necessary for nonlinear finite element analysis with very fine 3D solid elements

● **Achievements of the Year**

A FEM modeling which can predict the effect of defects in AFP laminates is proposed. Mechanical properties of CFRP laminates with gaps and overlaps are evaluated and stress concentration in the vicinity of gaps/overlaps are investigated. Additionally, influence of ply thickness is evaluated. The results obtained are as follows.

1) A modeling method was established that defines the physical properties of gaps/overlaps as a function of fiber volume fraction.

(2) It was found that stress concentration due to gaps/overlaps occurs around the edges of the gaps/overlaps, and the amount of stress concentration decreases as the width decreases. This is due to interference in stress concentrations at both ends when the width becomes below a specific value.

(3) It was found that using thin-ply prepregs reduces the amount of stress concentration and relaxation, and also narrows the stress affected area.
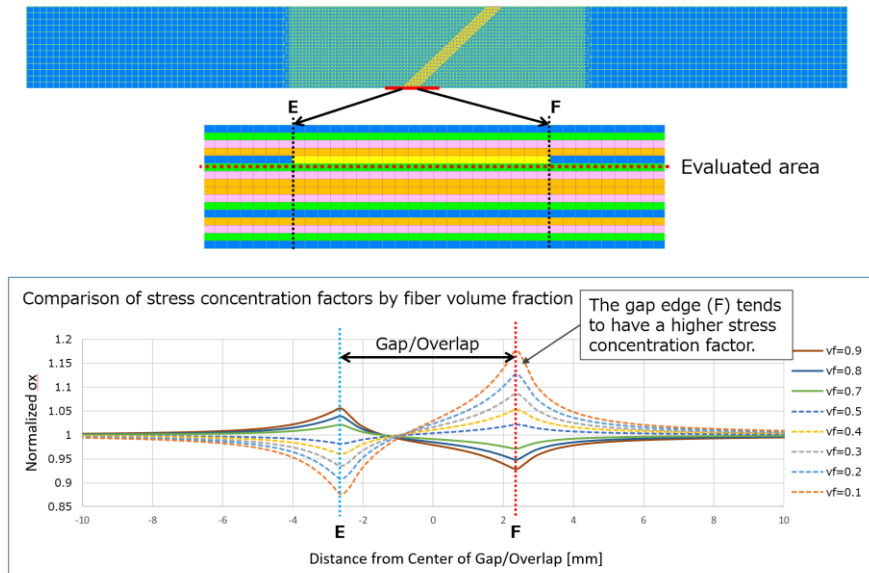
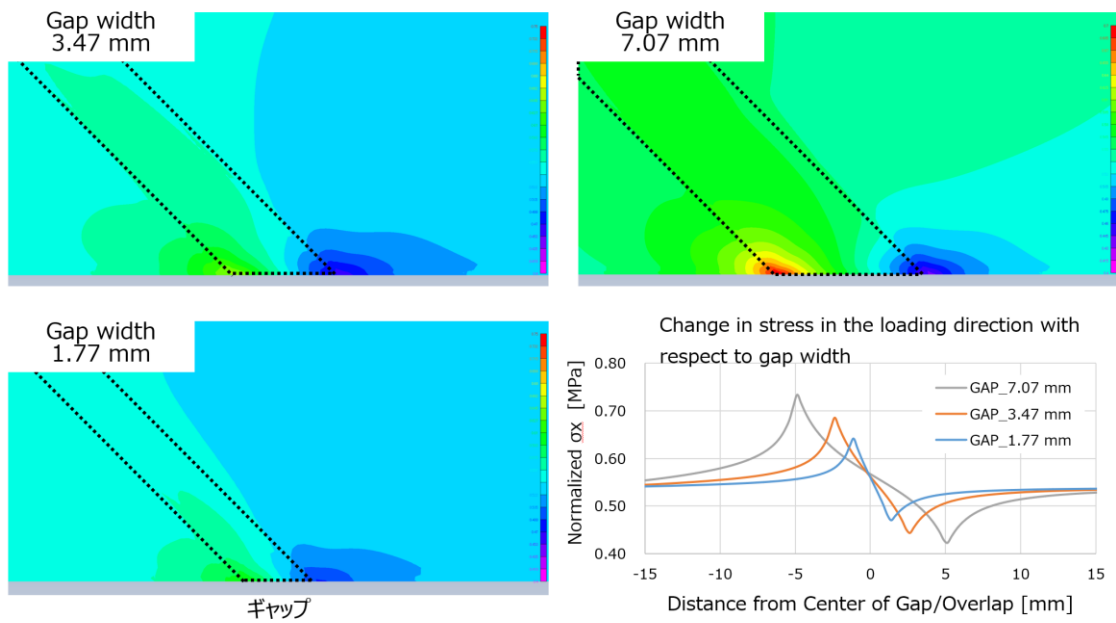Fig. 1: Evaluation of fiber volume fraction model

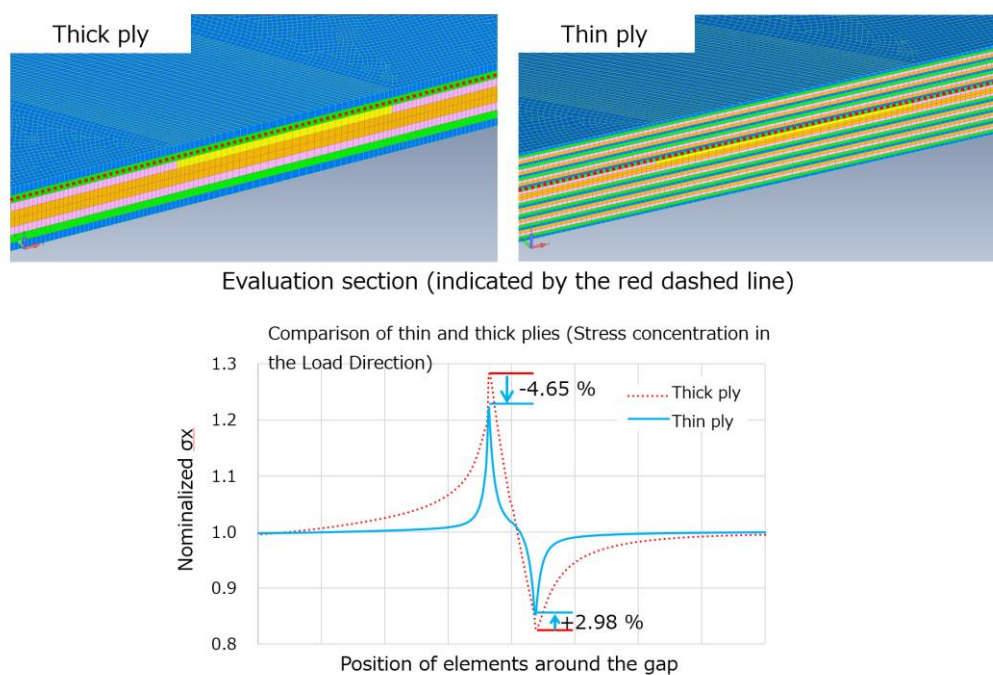Fig. 2: The effect of gap width on stress concentration

Fig. 3: Effect of ply thickness on stress concentration in Gap regions

● **Publications**

  - Oral Presentations

  Yasutomo Tateishi, Yoshiaki Yamaoka, Sho Miyashita, Yuichiro Aoki, Sunao Sugimoto, Toshiya Nakamura, A Study on Finite Element Modeling method for Thin-ply CFRP laminates with Gap/Overlap, The 60th The Aircraft Symposium, Niigata, October 2022.

● **Usage of JSS**

●   **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	2 - 256
Elapsed Time per Case	7200 Second(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources[1](%): 0.02

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	16,204.08	0.02
TOKI-GP	0.00	0.00
TOKI-XM	10,208.91	6.39
TOKI-LM	223.75	0.01
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[2] (%)
/home	428.89	0.39
/data and /data2	102,927.56	0.79
/ssd	477.78	0.07

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[2] (%)
J-SPACE	0.00	0.00

[1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[2]: Fraction of Usage : Percentage of usage relative to each resource used in one year.

● **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[2] (%)
ISV Software Licenses (Total)	0.00	0.00

[2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.

● **ISV Software Licenses Used**