EXTREME ENVIRONMENTS AND IMPACT LAB

Extreme Environments and Impact Laboratory

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- Education
B.S.   Department of Aerospace Engineering KAIST (2012)
Ph.D.   Department of Aerospace Engineering KAIST (2018)

- Experience
Post-doc Researcher   KAIST (2019)
Postdotoral Fellow   Hopkins Extreme Materials Institute, Johns Hopkins University (2021)
Assistant Professor   Pusan National University (2021-2022)
Assistant Professor   Seoul National University (2023)

- Experience
2021 Young Engineer   The Korean Society of Manufacturing Process Engineers
2018 Top excellence Research   (Ph.D.) KAIST
2018 Top excellent Presentation The Korean Society for Composite Materials

Collaborators

The "Extreme Environments and Impact Lab" at Seoul National Univ. is a research group dedicated to studying the behavior of materials and structures under extreme conditions. These conditions may include space environments, or low to hyper-velocity impact, among others. The lab conducts research on a wide range of topics related to extreme environments and impact, including the development of new materials and structural designs that are resistant to extreme conditions, the modeling and simulation of extreme events, and the testing and characterization of materials and structures under extreme conditions. The research conducted in the lab has the potential to enable the development of new technologies and systems that can operate effectively in extreme environments, and to improve the safety and reliability of existing technologies and systems.
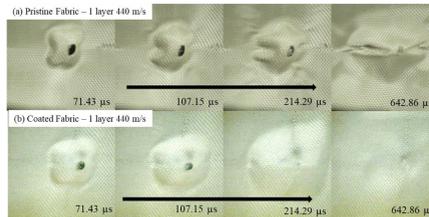
High-Velocity Impact for Various Materials

Resistance Characterization for Impact of Coated Fabrics
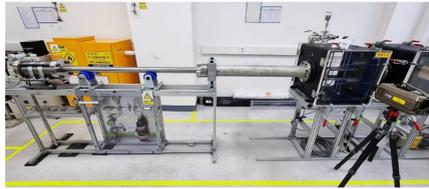
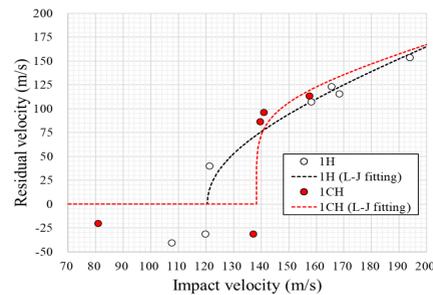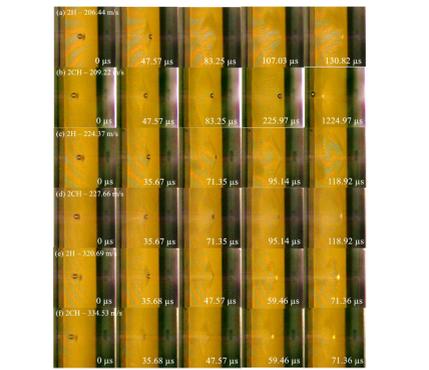

▲ Self-produced 1 Stage Gas Gun
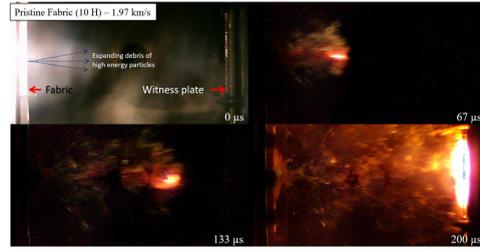
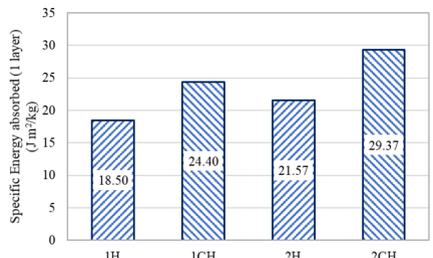▲ HV impact phenomenon captured by high-seed Camera

▲ Impact dynamic behavior of pristine/coated fabric
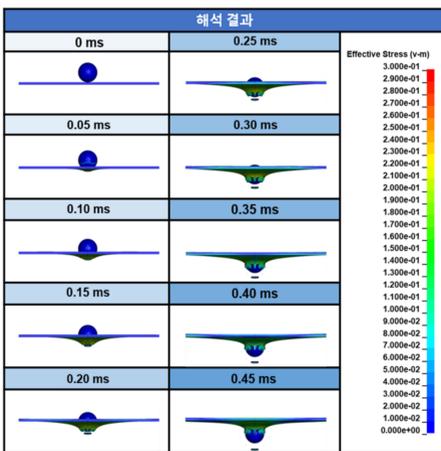
▲ Residual Velocity graph for the ballistic limit curve

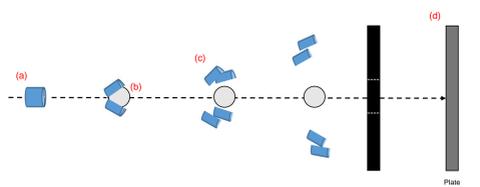▲ Impact dynamic behavior of pristine/coated fabric
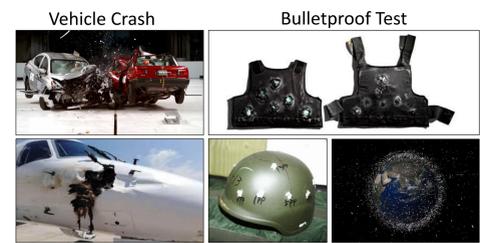
▲ Specific Energy absorbed at V_{BL}

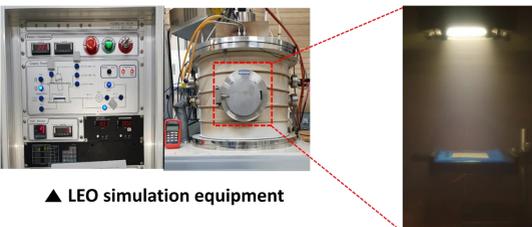### Projectile – Plate Impact / Sabot Separation System

▲ Sabot Separation System in 1-Stage Gas Gun

Vehicle Crash   Bulletproof Test

Bird strike   Bulletproof helmet   Space debris

▲ Application area

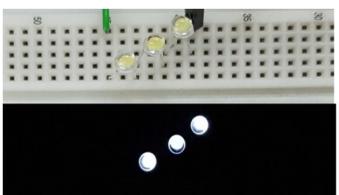▲ Ball-Plate High-Velocity Impact Simulation

Energy Generation using Piezo Sensor in LEO

Experiments of Energy Generation using AO in LEO environment
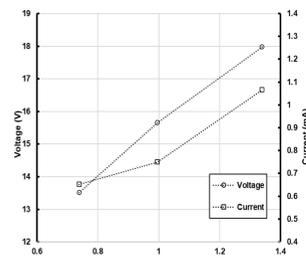

▲ LEO simulation equipment
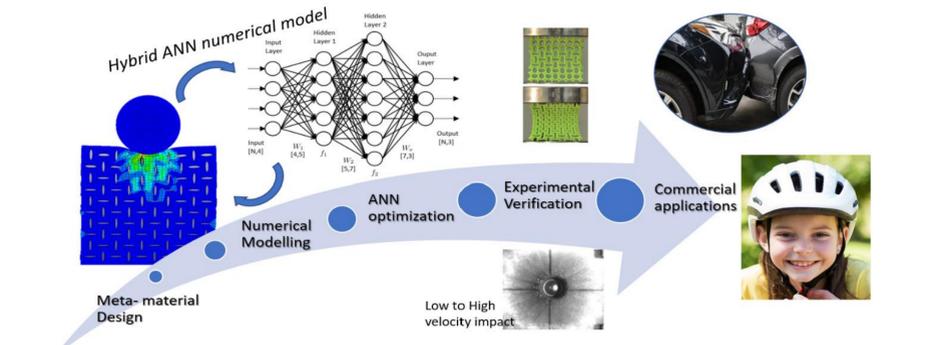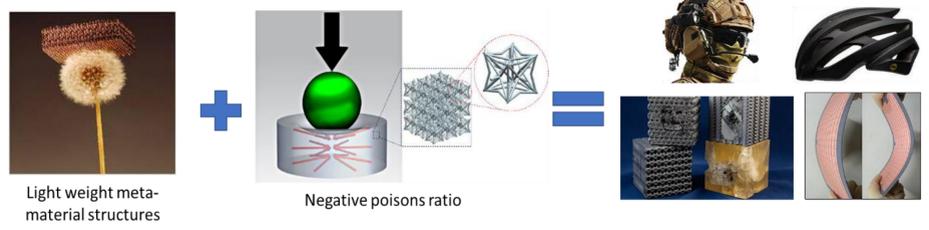
▲ Expose PZT sensor to the AO collision

PZT SEM image

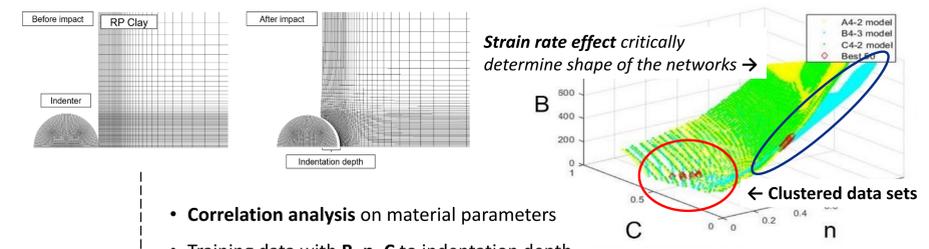▲ PZT sensor

▲ Energy generation

▲ Characterization of PZT

Artificial Neural Networks on Extreme Problem

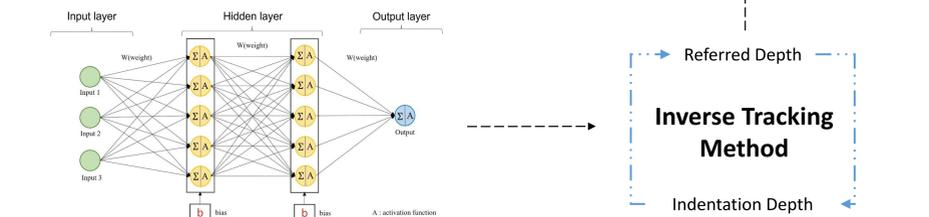### Hybrid ANN based Meta Material Design for Impact Protection

Light weight meta-material structures

Negative poisons ratio

Hybrid ANN numerical model

Meta- material Design

Numerical Modelling

ANN optimization

Experimental Verification

Commercial applications

Low to High velocity impact

▲ Optimizing meta material design through analysis, data preparation, and AI-based modeling

ANN & FEM Hybrid Modeling of the Soft Material

Strain rate effect critically determine shape of the networks

← Clustered data sets

- **Correlation analysis** on material parameters
- Training data with **B, n, C** to indentation depth

Input layer   Hidden layer   Output layer

Referred Depth

Inverse Tracking Method

Indentation Depth
- No separate mechanical experiments are required

▲ Designing ANN to determine optimal material parameters of ballistic clay

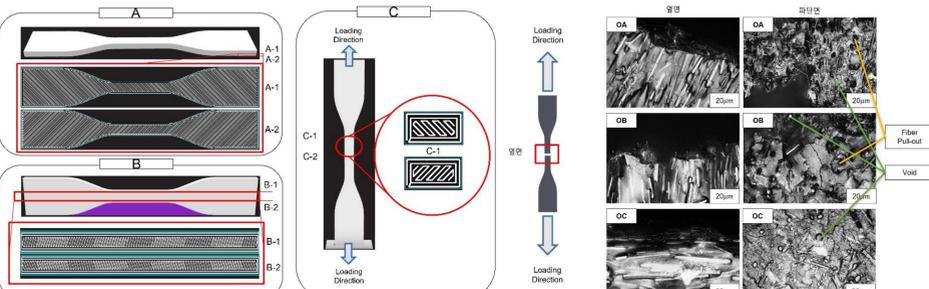### Product failure risk analysis using ANN and Impact Simulation
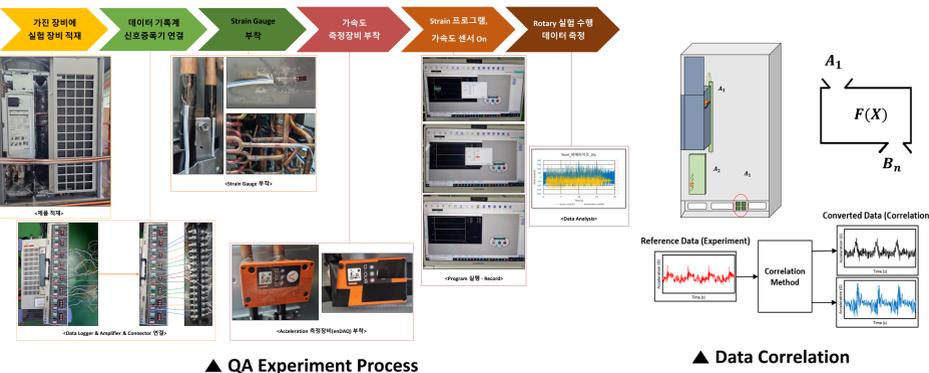
▲ QA Experiment Process

▲ Data Correlation

Mechanical Properties of 3D-Printed Composites

Mechanical Properties of 3D-Printed Composites

▲ Infill pattern of Onyx based on build orientation

▲ Microstructure of 3d-printed composite