



DIMEAS – Department of Mechanical and Aerospace Engineering
Politecnico di Torino
Ph.D. in Mechanical Engineering

Ph.D. student: Lorenzo Vigna

Research theme:

Crashworthiness of composite materials

Ph.D. scholarship funded by  **INSTRON**[®]

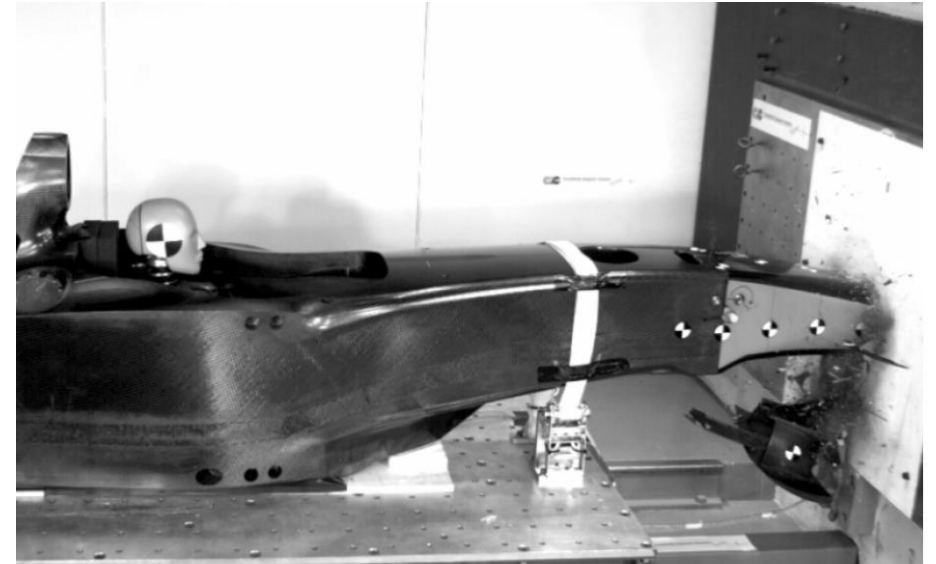
Scholarship: ITW Test And Measurement Italia Srl - Advanced Crashworthiness Assessment

Academic tutor: Prof. Davide Salvatore Paolino

Company supervisor: Giuseppe Galizia

Crashworthiness of composite materials

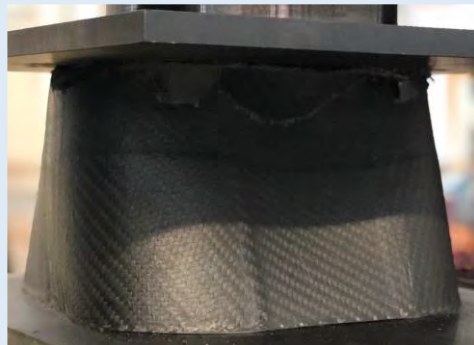
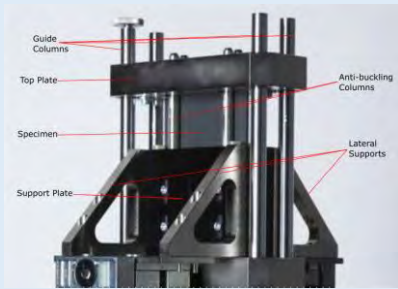
- Composites: extremely effective in absorbing kinetic energy during crash events.
- At present, several criticalities still prevent adoption of composite materials for crashworthiness applications:
 - Difficult prediction of the behavior of the structure during crash events.
 - Expensive destructive testing of prototypes.
 - Trial and error approach.
 - No existing standard for coupon testing.



Experimental and numerical approach

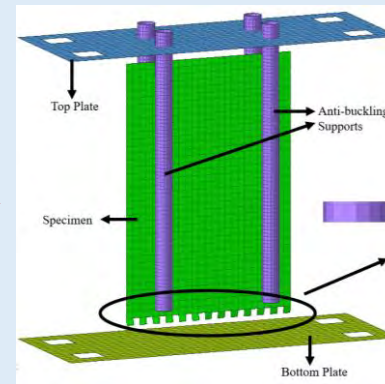
Experimental approach

Design of a fixture to measure the specific energy absorption (SEA) of a flat sample in a drop-dart test.



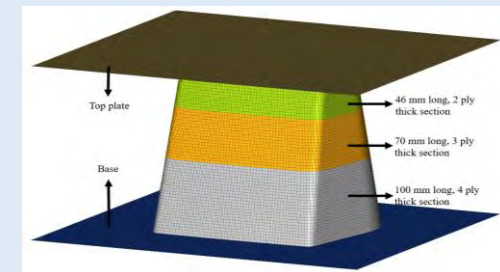
Validation with demonstrators.

Numerical approach

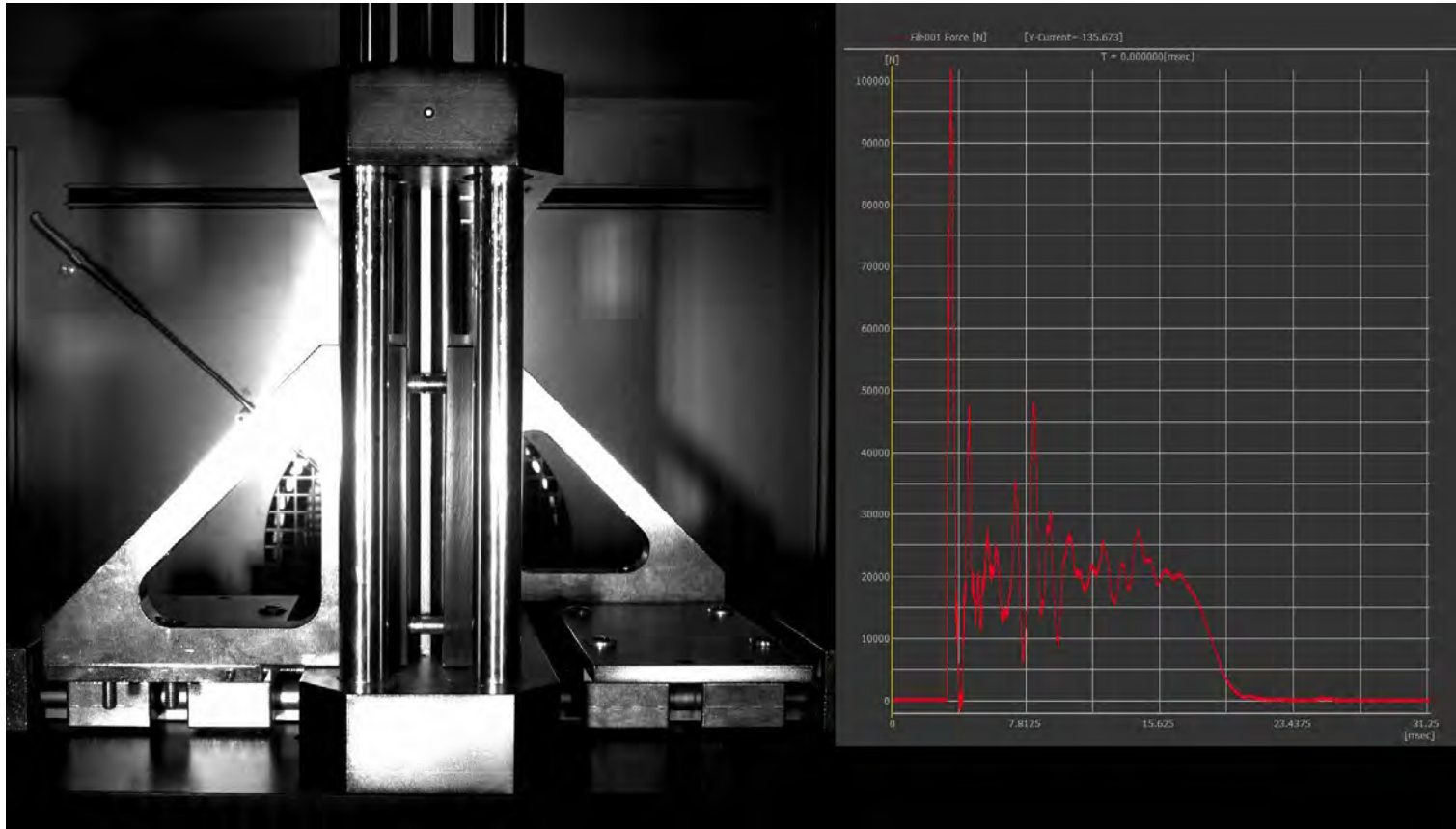


Simulation of the test and tuning of the material card with test results.

Modeling and simulation of complex structures with the tuned material card.

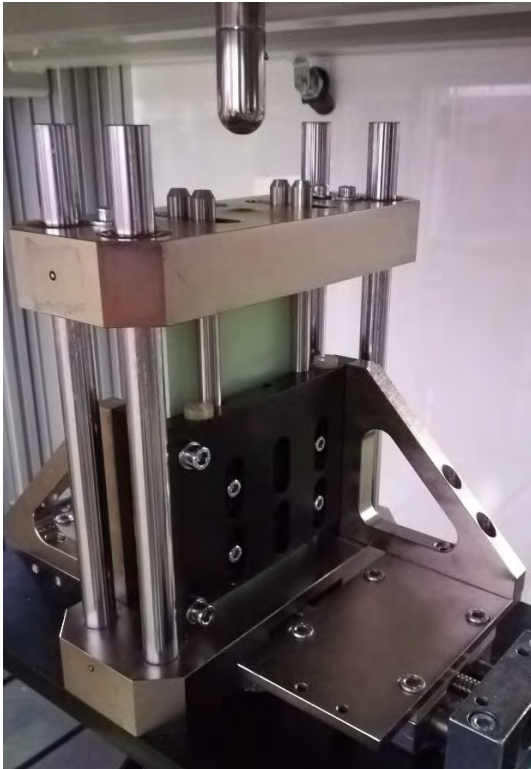


First results: fixture for crashworthiness test

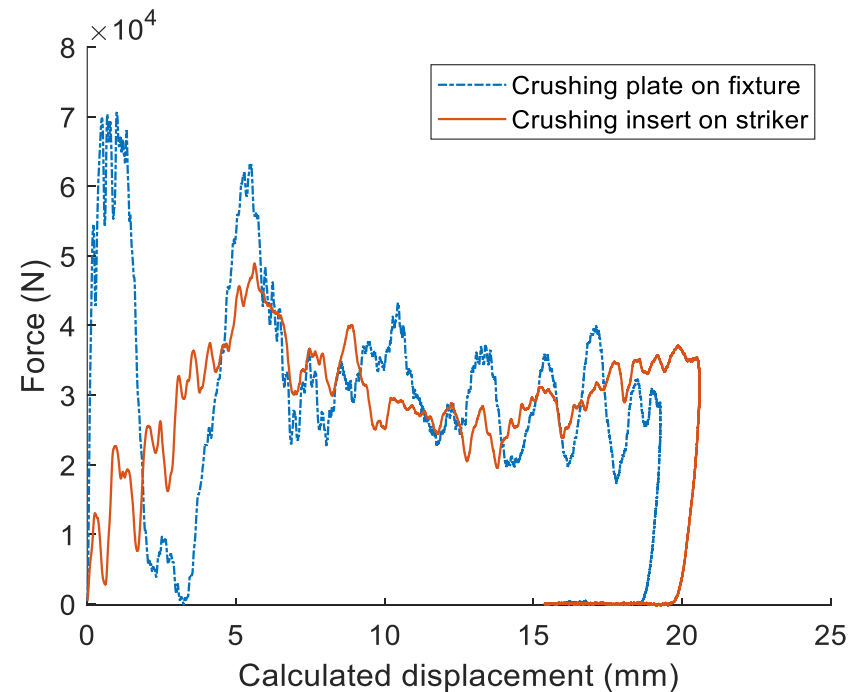
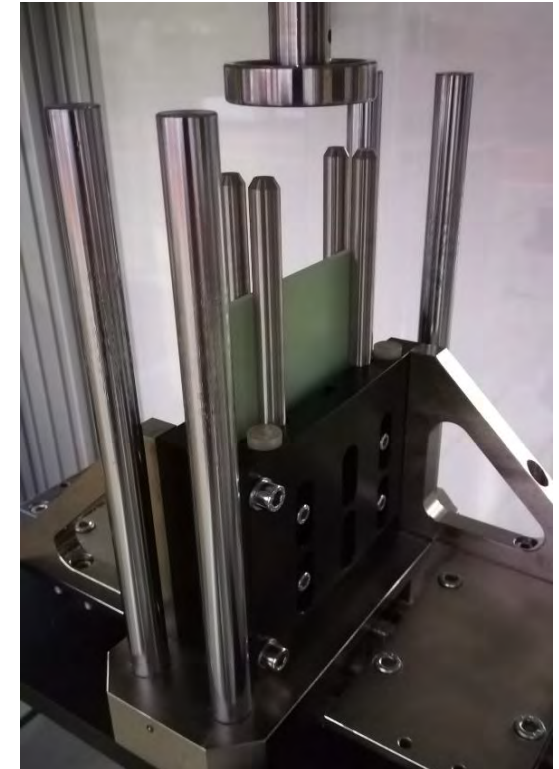


First results: fixture for crashworthiness tests

First design of the fixture



Improvement to avoid initial peak of force



Next steps

- New experiments:
 - Influence of several test parameters (mass, velocity, friction, unsupported height) on the crashworthiness properties.
 - Testing of different materials.
- New improvements on the fixture:
 - New design for improving robustness and ease of use.
- Simulation of the flat-coupon test:
 - Tuning of material card.
- Final validation:
 - Simulation and testing of complex shapes like tubes, open-section channels and crash-boxes.

Thank you