Automotive Composites: Damage and Repair

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Problem:
- Damage is going to occur throughout the life of a car from impacts, wear and tear and fatigue.

Solution:
- Detect the damage and repair it.
Damage Detection Methods

Detecting damage:

- Damage may be visible to the naked eye but this is not guaranteed.
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Damage Detection Methods

Detecting damage:

- Damage may be visible to the naked eye but this is not guaranteed.
- It may be obvious when to check for damage e.g. after a collision but when do you check for fatigue based damage?
- Methods for detecting non-visible or barely visible damage need to be quick, accurate and preferably require minimal training.
Damage Detection Methods

- Computer Tomography scan (CT-scan)
- Ultrasound methods
- Electrical resistance measurement
- Thermography
- UV dye methods
- Acoustic emission
Damage Detection Methods

CT-Scans

- Very powerful method providing a very accurate depiction of the test specimen.
Damage Detection Methods

CT-Scans

- Very powerful method providing a very accurate depiction of the test specimen.
- The machines are large and prohibitively expensive.
Damage Detection Methods

CT-Scans

Damage Detection Methods

Ultrasound

• Well established technology with different methods of use.
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- Ultrasound techniques can be difficult to perform in complex geometries.
- They will require some skill in interpreting the results.
- They can be quite labour intensive.
Damage Detection Methods

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- Limited ability to provide location of damage.
Damage Detection Methods

Thermography

- Can scan relatively large areas in one go.
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Thermography

- Can scan relatively large areas in one go.
- Ultrasonic and electrical heating methods have shown good ability to detect small scale damage.
Detected low velocity damage in composite plate using nonlinear acoustic/ultrasound methods.
Damage Detection Methods

UV fluorescent dye release

- Only requires eyes and a UV lamp to perform inspection.
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- Damage must cause dye to be released.
Damage Detection Methods

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- Damage must cause dye to be released.
- Dye must have a sufficient lifetime.
UV fluorescent dye release

Damage Detection Methods

There are many different methods that could work for the automotive sector so long as they are cheap and accurate enough. Non-destructive testing and structural health monitoring for composite structures are very active fields of research.
Repair Methods

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- Mostly involve replacing damaged sections.
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Repair Methods

Repairing Damage:

• Mostly involve replacing damaged sections.
• Need to be as simple to perform as possible.
• Need to reliably restore necessary strength and stiffness.
Repair Methods

BMW repair method


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Conclusions

- Damage needs to be detected and classified with minimal skill, minimal equipment cost and as quickly as possible.