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Materials & Manufacturing Research Institute Experience Innovation with Us



# Composites and Optimization Research@ UBC Okanagan

A path to effective and lowrisk, knowledge-based composites manufacturing and design PI: Abbas S. Milani, Ph.D., P.Eng.

> http://crno.ok.ubc.ca https://mmri.ubc.ca/



# Vision: Filling the gap between Academia and Industry, specially on fabric composites field



- Basic Research
- Narrow focus, great detail
- Little attention to integration
- Academic papers
- Hands-off interest in use of knowledge
- Slow and methodical

- Wide focus
- Integration is critical
- Often get the desired result without knowing why
- Fast and results-oriented



# **Examples of recognition**

**Our Research Featured in:** 

# materialstoday

https://www.materialstoday.com/composite-processing/news/removing-the-wrinkles-from-woven-fabrics/

#### Advanced Textiles Source 🚇

https://advancedtextilessource.com/2018/08/06/tackling-wrinkling-in-advanced-textile-composites/



https://www.theguardian.com/world/2018/jul/13/canada-shopping-cart-design-homelessness



# **Testing Facility and Support**





# Fabric composites research workflow





### In-house advanced characterization capabilities

**Dedicated in-house fixtures for testing fibrous and polymeric materials** 





Coupled **Biaxial tension** + Shear



Characterization of multi-layered NCF and woven fabrics



#### Bending









**Inter-ply Friction** 



111111



Other equipment including but not limited to:

- **Dynamic Mechanical Analyser** •
- **Digital Image Correlator** .
- **Thermal Conductivity Tester**
- Weather Monitoring Station and Exposure Racks ٠
- **Differential Scanning Calorimeter** ٠
- **Roughness Profilometer/Interferometer**
- **Hydraulic Hot Press**
- **Environmental Chamber**
- Drop weight tower and SHPB high strain rate impact set up
- Online strain monitoring via embedded stretchable sensors

# Advanced multi-scale simulation examples

#### Meso-level (yarn-scale)



Shear and wrinkling modeling of fibreglass/PP Twintex

#### Macro-level (ply-scale)



Intra-ply shear simulation of Carbon/epoxy automotive prepregs

#### **Process Modeling**





Simulation of wrinkling in aerospace prepregs



**Bending simulation of Twintex** 





3-point bending simulation of Angled laminates



Heat transfer/flow compaction modeling of autoclave cure process

Impact Modeling of UD and Fabric cured composites



forming process

### **Non-destructive testing capability**

• Micro-Computed X-Ray Tomography with *in-situ* thermomechanical testing stage



3D Rendering of consolidated glass/PP specimen

Visualization of 3K plain weave carbon fabric



In-situ tensile testing of misaligned UD glass fibers



Zeiss/Xradia micro 400 system

• 3D Scanning



Characterization of forming-induced wrinkling employing 3D scanner

• UT Bond Tester

**FLIR Infrared system** 



Delamination detection of autoclave-processed CFRP



Thermal monitoring of CFRP laminates



### Machine Learning for composites manufacturing

- Advanced theory-guided greybox and black-box modeling
- Material design, process modeling, in-situ process management applications
- Big data integration strategies
- Industry 4.0





### Smart sensors research for fabrics and composites

- Sensor fabrication and characterization
- Human-robot interaction
- Embedded sensors for process and lifecycle monitoring
- Industry 4.0 integration
- Machine learning analytics and optimisation







### Select List of Supporting Organizations and Collaborating Universities



## **Research Themes & Sample Collaborating Sectors**



Composites **Research** Networ

### Contact

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