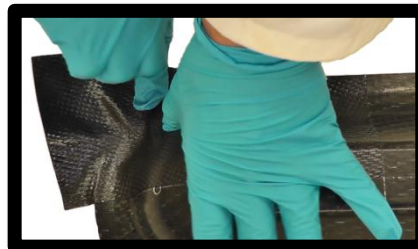
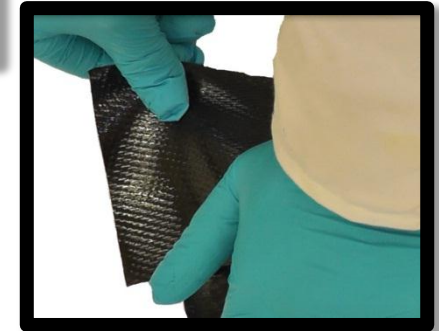
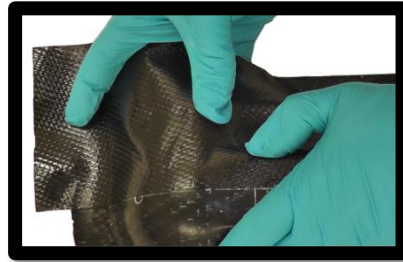


HUMAN INSPIRED AUTOMATED LAYUP

Michael Elkington

*Supervisor – Prof. Kevin Potter
& Dr. Carwyn Ward*

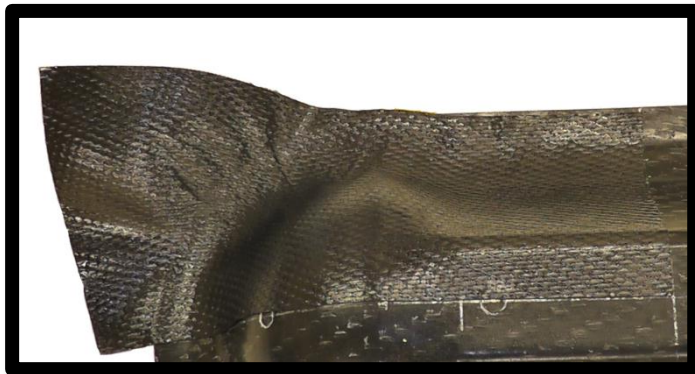
1: Understanding Hand lamination



Multiple repeated actions used to apply shear.

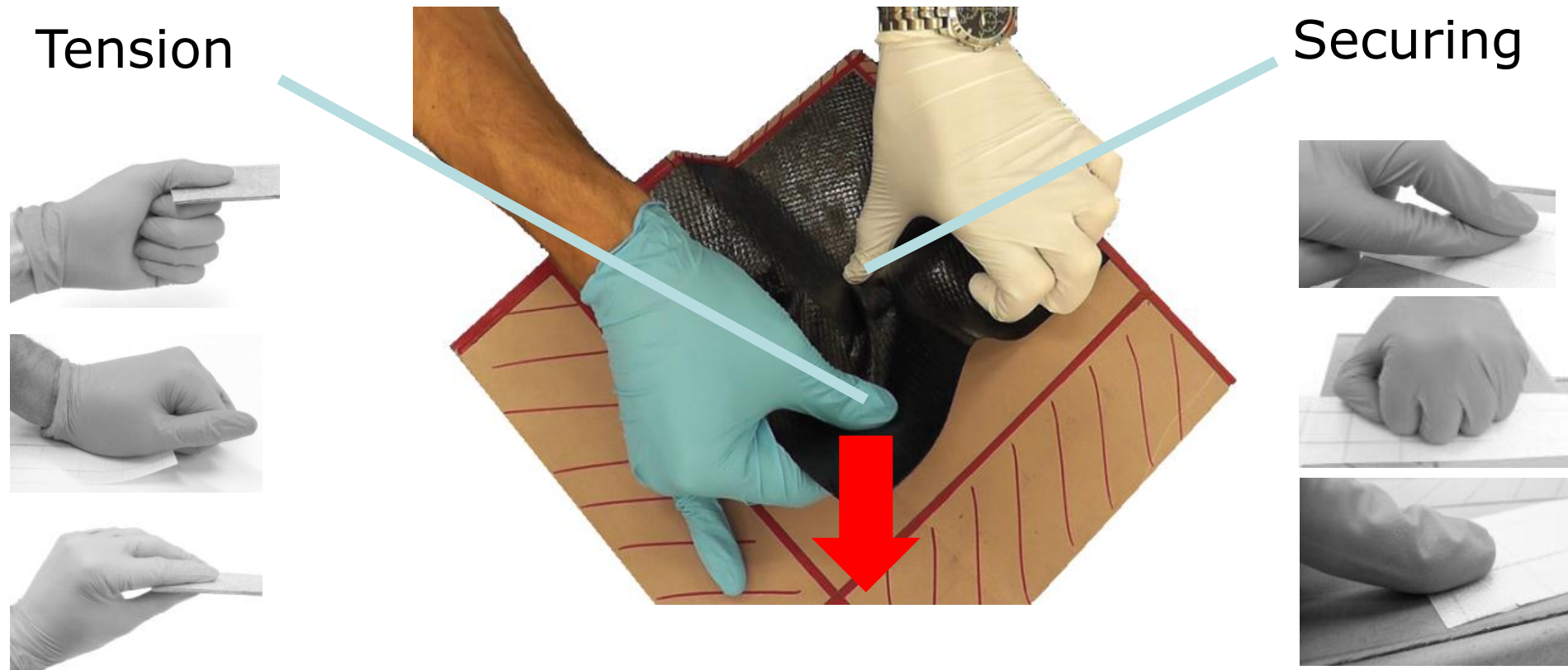
- **Woven Prepreg**

- **Doubly curved parts**



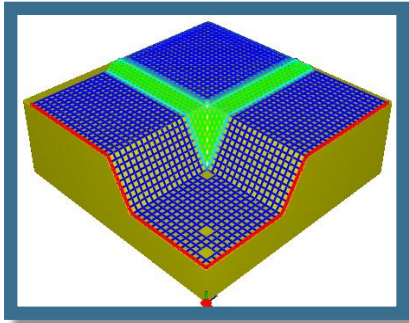
1: Understanding Hand lamination

- Layup trails: 19 Tasks, 6 laminators.
- Visual Analysis revealed 7 commonly used techniques
- Example: ***Tension – Securing shearing,***



2: Pre-shearing – The evolution

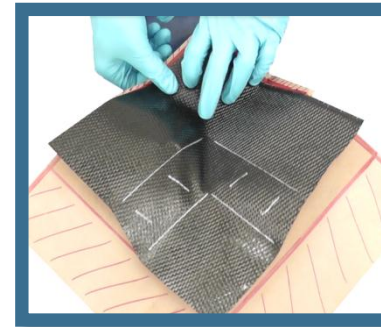
Apply shear *Before* any contact with the tool



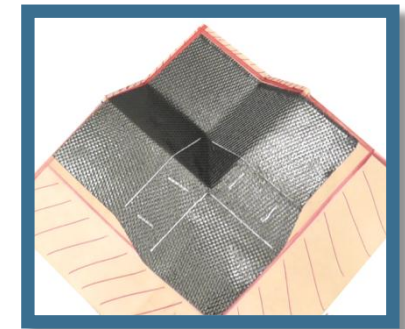
Start with a kinematic model



Apply shear prior to tool contact.

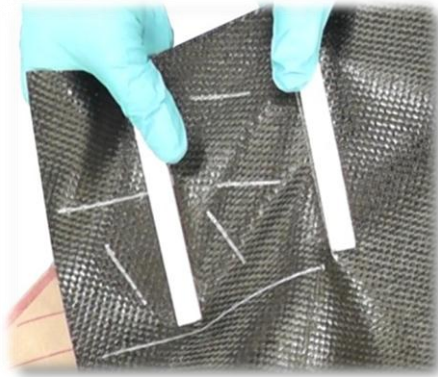


Ply fits easily into tool.

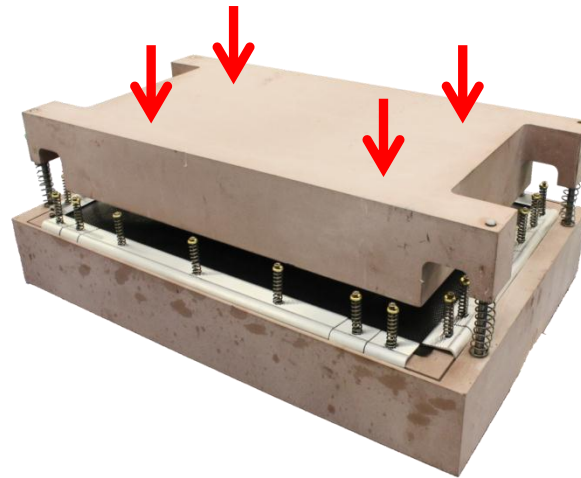
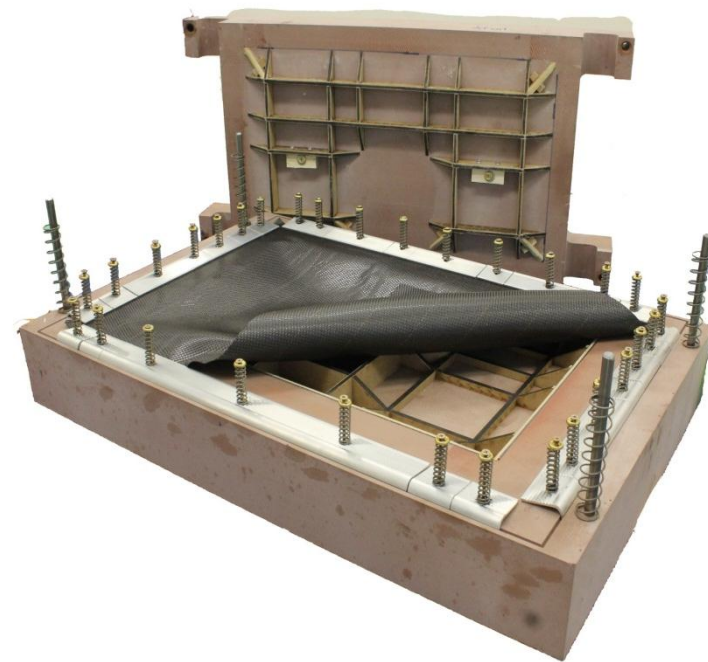


- **60% reduction in *on tool* layup time**
- **Significant reduction in defects**
- **75% less actions - Simplified**

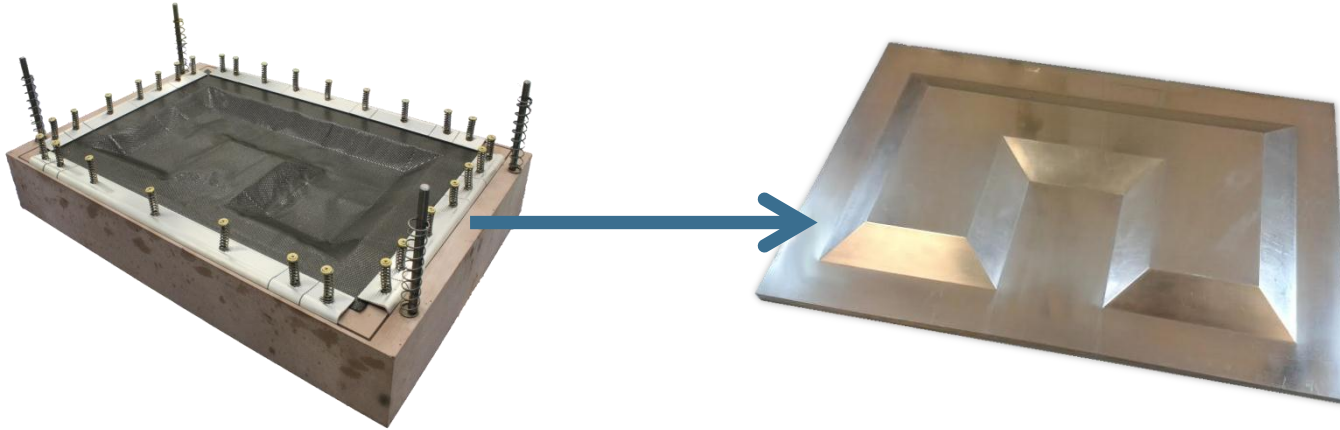
3: Automated preshearing



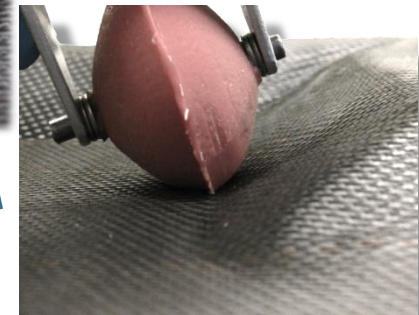
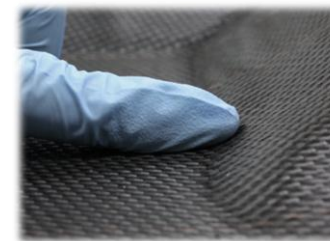
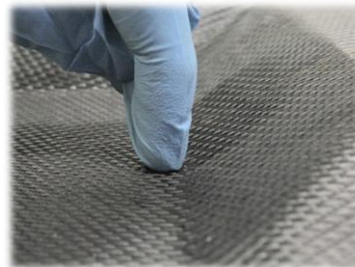
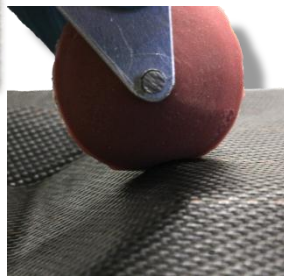
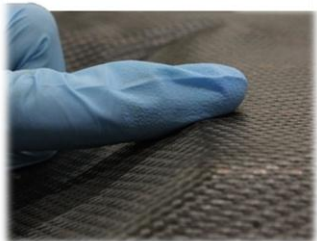
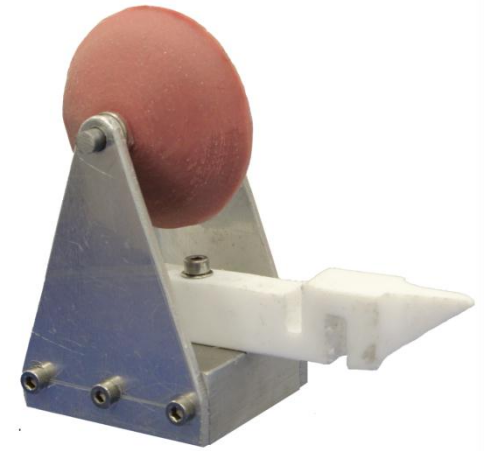
Preshearing is automated using a two part press



4: Automated layup



Custom end effector for six axis robot:
Shape and application methods inspired
by the hand layup process.



Thanks you for listening.

Questions and ideas welcome.

Acknowledgments:

- Dr Anna Chatzimichali and Dominic Bloom

