Design and Optimization of Wind Turbine Blades
Using Variable Stiffness Method

Context: For reasons of improved structural efficiency, carbon fibre composite materials are being increasingly used as a primary structural material. This is evidenced by the recent increase in carbon fibre content in the recent large aircraft designs. For many structural applications sandwich construction proves to be one of the most efficient structural configurations. However, there are many practical design considerations that need to be taken into account (e.g., face sheet laminate choice, connections and joints, core design, etc.). Manufacturing considerations also play a predominant role in the design process, especially those that are based on advanced automated fabrication technologies. For example, in order to maximise production efficiency, tow-placement technology offers an efficient and automated production process which is ideally suited for the production of sandwich constructions.

In order to maximise structural efficiency, the design of sandwich constructions need to consider all possible design variables and their corresponding spatial variation. For example, through the use of advanced tow placement technology, it is possible to create laminates that have variable in-plane and bending stiffness matrices over the entire planform of stiffened panel configurations. Considerations of spatial variability introduce many modelling and manufacturing complications.

Objective: The development of preliminary and detailed design methodologies for optimum stiffness distribution of complex shaped (in 3-D) sandwich constructions laminates with fully integrated fabrication considerations that will yield spatially variable fibre orientation distribution.

Applications:

- Next generation Wind Turbine rotor blades
- Aircraft fuselage panels.
- Advanced see/land vehicle applications