Delamination resistance in composite materials

Background & problem
Composites are renowned for their high specific stiffness and strength. Hence, these materials are well suited for applications where weight is important, such as aircraft, racing cars or wind turbines. The main weakness of composite materials is their proneness to delamination, which is the debonding of layers in the composite due to out-of-plane loading.

Clearly, the resistance to delamination is an important property of these composite materials. As such, many experimental methods are available to characterize the delamination resistance. However, the vast majority of these methods are designed to characterize the delamination resistance between two layers, which both have their fibers aligned parallel to the crack propagation direction. This is rather unfortunate as this particular case has little practical value. In practical applications, the consecutive composite layers are often oriented at an angle of 45° relative to each other. Moreover, the crack may propagate in any direction, depending on the specific loading case.

Recently, the mandrel peel test has been introduced as an alternative test method to characterize the delamination resistance between two plies having a different fiber orientation. Moreover, potentially the method also allows variation of the crack propagation direction.

Objective
The ultimate objective is to assess the applicability of the mandrel peel test to quantify the delamination resistance between two layers oriented at 45° with respect to each for arbitrary crack propagation directions. The work can roughly be subdivided into the following tasks:

i. Development of a test methodology; this includes specimen design, test parameter analysis and data analysis development.
ii. Design of an experimental program and the execution thereof.
iii. Analysis of the results and comparison with accepted test methods.
iv. Discussion of the results in a written scientific report.

Interested? Feel free to contact Wouter Grouve, w.j.b.grouve@utwente.nl, N-206.