An elastic-interface model for buckling-driven delamination growth in composite panels under bending

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**Introduction**

Delamination of composite laminates can have multiple causes, such as manufacturing defects, high interlaminar stresses, low-energy impacts, etc. Delamination cracks propagate under both static and fatigue loads [1]. We analyse the delamination growth promoted by local buckling in a laminate subjected to four-point bending [2].

**Mathematical problem**

The model is described by a set of 10 differential equations + 30 b.c.

\[
\begin{align*}
E_{ij} v_1''(z) + B K_z (v_1(z) - v_2(z)) - \frac{1}{2} H_1 E_{ij} w_1''(z) &= 0 \\
E_{ij} v_2''(z) + B K_z (v_2(z) - v_1(z)) + \frac{1}{2} H_2 v_1''(z) &= 0 \\
E_{ij} w_1''(z) &= B K_z (w_1(z) - w_2(z)) + \frac{1}{2} H_2 v_2''(z) \\
E_{ij} w_2''(z) &= -B K_z (w_1(z) - w_2(z)) + \frac{1}{2} H_2 v_1''(z) \\
E_{ij} v_1''(z) + P_4 v_1''(z) &= 0 \\
E_{ij} v_2''(z) &= 0 \\
E_{ij} w_1''(z) &= 0 \\
E_{ij} w_2''(z) &= 0 \\
E_{ij} v_1''(z) &= 0 \\
E_{ij} w_2''(z) &= 0
\end{align*}
\]

A general analytical solution is deduced for the differential problem. The b.c. are non-linear with respect to the axial force in the buckled sublaminates, \( P_4 \). By taking the latter quantity as a representation parameter, numerical solutions are determined for specific problems.

**Mechanical model**

The mechanical model considers the specimen as an assemblage of sublaminates, modelled as beams, partly connected by an elastic interface.

**Applied bending moment vs. \( P_4 \)**

**Delamination growth**

**Equilibrium path**

**Essential references**
