Axisymmetric problems in continuum mechanics with transversely isotropic materials

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We investigate problems consisting of a axisymmetric body under axisymmetric load with radial, longitudinal and rotational degrees of freedom. The fundamental equations are deduced in a short and elegant way. The decoupling of the rotational degree of freedom from both other is derived for isotropic materials and two quite limiting cases of transversely isotropic material. In a straightforward way we apply error estimators, adaptive refinement and hierarchical preconditioning to achieve a fast solver for this important class of problems.

Furthermore we investigate a hydrogen tank under internal pressure. The tank consists of a steel liner and several layers of carbon rovings with different fibre directions. Due to the process of winding the rovings around the liner, the fibres are geodesics, with respect to some intermediate surface. As a consequence of Clairaut's relation $R(\zeta)\cos\varphi(\zeta) = \text{const}$ the maximum altitude ζ of a geodesic is bounded if the radius R tends to zero. This influences the geometry of the tank and some post processing is shown for the specified problem.

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