Hydrodynamics and Elasticity 2023/2024

Sheet 4

One of the problems will be handed in and marked.

Problem 1   Consider again the pipe/sausage problem analyzed during the tutorials, but this time do not assume that the system is clamped in the axial direction (i.e. allow nonzero u_z). What is the deformation, strain and stress tensor in such a case?

Problem 2   Calculate the displacement, strain, and stress for a clamped pipe subject to an external pressure p with zero internal pressure. Can the pipe wall actually thicken during compression?

Problem 3   There is a spherical cavity of radius R filled with gas under pressure p in an unbounded elastic medium. The medium is free from stresses at infinity. Determine the components of the stress and strain tensors

(*) Problem 4   Consider a cylindrical pipe with inner radius a, outer radius b and infinite length made from homogeneous and isotropic elastic material. The external surface of the pipe is fixed (no deformation there). The pipe is deformed by the axial tension $\tau_0 \mathbf{e}_z$ applied uniformly along its internal surface. Find the deformation field and stress tensor in such a system.

Hint: Symmetry of the problem implies that $\mathbf{u} = u_r(r)\mathbf{e_r} + u_z(r)\mathbf{e_z}$.

Maciej Lisicki & Piotr Szymczak