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ESTIMATION OF STRESSES IN ARTERIAL TISSUE: FROM RESIDUAL STRESSES TO MATERIAL PARAMETERS.

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Abstract. In the past decades a considerable amount of literature has been published addressing the study of the mechanical behavior of arterial walls. In these works, researchers have developed constitutive models and characterized the typical ranges for the values of material parameters of vascular tissues. Moreover, the existence of residual stresses in configurations free of loads was revealed, and its impact in the general stress state of the tissue was quantified. Currently, ex-vivo experiments such as inflation-extension tests and biaxial stress tests are extensively used for the estimation of the constitutive parameters in arterial wall probes. Also, destructive experiments involving radial cutting of specimens and the separation of arterial layers are used to identify layer-specific residual deformations (and stresses). For the latter scenario, material parameters are assumed to be known. In this context, a technique for the simultaneous characterization of residual deformations and material parameters in the arterial wall is proposed. This approach is based on data tipically obtained from inflation-extension tests, assuming that the material configuration and the radial displacement of the vessel is known for different load conditions given by fixed axial stretch and internal pressure values. The characterization problem is tackled through the minimization of a cost functional that measures the mechanical disequilibrium of the known material configuration and the discrepancy between the predicted and observed displacement of the outer vessel boundary. To illustrate the feasibility of the proposed methodology a manufactured-solution example is presented.