Within this contribution the algorithmic treatment of the inverse problem of finding mechanically motivated membrane shapes is discussed and the key point, that the corresponding numerical methods have a broader spectrum of applications which enables their adoption to similar problems from other disciplines, is highlighted. The presented adaptive scheme is the Updated Reference Strategy (URS) enhanced by a newly derived “element distortion control”. The key feature is the ability of the proposed stabilized scheme to overcome the singular problem of finding equilibrium shapes of prestressed membranes which is due to the non–uniqueness of nodal positions in the finite element mesh and the purposeful adjustment of the underlying stress state based on a local geometrical criterion in case of incompatible stress states. Therefore, the derived methodology is –beside the mere computation of equilibrium configurations– able to distribute (probably very local) deformations of the mesh in a smooth way to the whole domain by at the same time conserving specific mesh characteristics which guarantees regular meshes with high quality concerning the element shape. This results in robust computations even for complex and problematic geometrical situations. Due to the effective mesh control of this approach a transfer of the developed methodology to other fields of application like e.g. mesh smoothing,
large displacement mesh moving problems and stabilized CAD–free shape optimization of shells is promising and therefore accomplished. (© 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim)