Weak imposition of constraints for multipatch membrane structures in transient geometrically nonlinear isogeometric analysis

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Membranes have been extensively used for the design of architectural and general structural models due to their low cost and high load capacity behaviour. Traditionally such models were discretized using the classical low order *Finite Element Method* (FEM) which typically results in a compromised description of the geometry. However the accurate geometry description of those structures is essential as for instance bifurcation points in geometrically nonlinear analysis may or may not be accurately predicted when the geometry description of the model is not accurate enough. In this contribution, the form-finding analysis using the *Updated Reference Strategy* (URS) and the geometrically nonlinear transient analysis of membranes is extended to multipatch *Isogeometric Analysis* (IGA) using *Non-Uniform Rational B-Splines* (NURBS). As typical in IGA for real CAD geometries, multiple patches with non-matching parametrizations are considered and therefore the continuity of the solution field and the application of weak Dirichlet boundary conditions need to be addressed. Thus, four different constraint enforcement methods are elaborated and compared, namely, the *Penalty*, the *Lagrange Multipliers*, the *augmented Lagrange Multipliers* and a *Nitsche*-type method. For the latter method, a solution dependent stabilization approach is employed in order to render the Nitsche-type method coercive. All methods are elaborated and systematically compared in both, form-finding analysis, whenever necessary, and subsequently in geometrically nonlinear transient analysis. The results suggest that the Nitsche-type method is advantageous for these kinds of problems as no parameter or discretization other than the isogeometric discretization of each patch needs to be specified prior to the analysis.