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Shape Morphing Techniques to Adapt Pelvic Structures

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Pelvic organ prolapse (POP) is considered a challenging disorder that occurs when the pelvic support structures fail. It is caused by several reasons, the most common being pregnancy and vaginal birth, both of which can result in pelvic floor muscle and connective tissue injury. An improved visualization of this condition is obtained with computational modeling. It becomes possible to simulate various clinical outcomes by developing specific models that reproduce the mechanical and geometric characteristics of an anatomical region of interest from biomedical images, intended for diagnostic, therapeutic, or surgical purposes. When they are sufficiently reliable, these models can represent a virtual patient, thus being able to replace human clinical evaluation in some situations.

Nowadays, all but the simplest problems are analyzed and solved with the help of computer softwares that speed up calculations. To study the biomechanical behavior of anatomical structures the FEM (Finite Element Method) is used. The development of 3D pelvic models must take into consideration the shape of the structure and its biomechanical response, such behaviour is heavily influenced by its geometry. The pre-processing setup can be very time-consuming when the FE model is based on real images, particularly in 3D, and when the task must be replicated multiple times for similar applications.

Our goal is to apply the developed algorithm to a real anatomical structure obtained from real MRI images. The goal of this study is to apply the developed algorithm to a real anatomical structure obtained from real MRI images. For this, there are a great number of techniques to adapt the shape of a geometry, for this study radial basis functions (RBFs) based mesh morphing are used [1]. This method works by adapting the geometry's shape based on the update of its nodes positions. We begin with the extraction of the nodal coordinates required to adapt the structure. To achieve a shape variation, the displacement was applied to each pre-existing node taking into account its boundary conditions, resulting in an updated location of the set of control points.

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