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1.Most Downloaded

Mechanical properties and the hierarchical structure of bone

Abstract

Detailed descriptions of the structural features of bone abound in the literature; however, the mechanical properties of bone, in particular those at the micro- and nano-structural level, remain poorly understood. This paper surveys the mechanical data that are available, with an emphasis on the relationship between the complex hierarchical structure of bone and its mechanical properties. Attempts to predict the mechanical properties of bone by applying composite rule of mixtures formulae have been only moderately successful, making it clear that an accurate model should include the molecular interactions or physical mechanisms involved in transfer of load across the bone material subunits. Models of this sort cannot be constructed before more information is available about the interactions between the various organic and inorganic components. Therefore, further investigations of mechanical properties at the `materials level', in addition to the studies at the `structural level' are needed to fill the gap in our present knowledge and to achieve a complete understanding of the mechanical properties of bone.

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2. Recent Articles

Influence of spinal disc translational stiffness on the lumbar spinal loads, ligament forces and trunk muscle forces during upper body inclination

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Abstract

Inverse dynamic musculoskeletal human body models are commonly used to predict the spinal loads and trunk muscle forces. These models include rigid body segments, mechanical joints, active and passive structural components such as muscles, tendons and ligaments. Several studies used simple definition of lumbar spinal discs idealized as spherical joints with infinite translational stiffness. The aim of the current sensitivity study was to investigate the influence of disc translational stiffness (shear and compressive stiffness) on the joint kinematics and forces in intervertebral discs (L1−L5), trunk muscles and ligaments for an intermediately flexed position (55°).

Based on *in vitro* data, a range of disc shear stiffness (100−200N/mm) and compressive stiffness (1900−2700N/mm) was considered in the model using the technique of force dependent kinematics (FDK). Range of variation in spinal loads, trunk muscle forces and ligaments forces were calculated (with & without load in hands) and compared with the results of reference model (RM) having infinite translational stiffness. The discs' centers of rotation (CoR) were computed for L3−L4 and L4−L5 motion segments.

Between RM and FDK models, maximum differences in compressive forces were 7% (L1−L2 & L2−L3), 8% (L3−L4) and 6% (L4−L5) whereas in shear forces 35% (L1−L2), 47% (L2−L3), 45% (L3−L4) and more than 100% in L4−L5. Maximum differences in the sum of global and local muscle forces were approximately 10%, whereas in ligament forces were 27% (supraspinous), 40% (interspinous), 56% (intertransverse), 58% (lig. flavum) and 100% (lig. posterior). The CoRs were predicted posteriorly, below (L3−L4) and in the disc (L4−L5).

FDK model predicted lower spinal loads, ligament forces and varied distribution of global and local muscle forces. Consideration of translational stiffnesses influenced the model results and showed increased differences with lower stiffness values.

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3.Most Cited

Review of control algorithms for robotic ankle systems in lower-limb orthoses, prostheses, and exoskeletons

Abstract

This review focuses on control strategies for robotic ankle systems in active and semiactive lower-limb orthoses, prostheses, and exoskeletons. Special attention is paid to algorithms for gait phase identification, adaptation to different walking conditions, and motion intention recognition. The relevant aspects of hardware configuration and hardware-level controllers are discussed as well. Control algorithms proposed for other actuated lower-limb joints (knee and/or hip), with potential applicability to the development of ankle devices, are also included.

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4. Open Access Articles

مقاله زیر بصورت کامل قابل دریافت و درصورت تمایل قابل ترجمه می باشد

A framework for computational fluid dynamic analyses of patient-specific stented coronary arteries from optical coherence tomography images

Abstract

The clinical challenge of percutaneous coronary interventions (PCI) is highly dependent on the recognition of the coronary anatomy of each individual. The classic imaging modality used for PCI is angiography, but advanced imaging techniques that are routinely performed during PCI, like optical coherence tomography (OCT), may provide detailed knowledge of the pre-intervention vessel anatomy as well as the post-procedural assessment of the specific stent-to-vessel interactions. Computational fluid dynamics (CFD) is an emerging investigational tool in the setting of optimization of PCI results. In this study, an OCT-based reconstruction method was developed for the execution of CFD simulations of patient-specific coronary artery models which include the actual geometry of the implanted stent.

The method was applied to a rigid phantom resembling a stented segment of the left anterior descending coronary artery. The segmentation algorithm was validated against manual segmentation. A strong correlation was found between automatic and manual segmentation of lumen in terms of area values. Similarity indices resulted >96% for the lumen segmentation and >77% for the stent strut segmentation. The 3D reconstruction achieved for the stented

phantom was also assessed with the geometry provided by X-ray computed micro tomography scan, used as ground truth, and showed the incidence of distortion from catheter-based imaging techniques. The 3D reconstruction was successfully used to perform CFD analyses, demonstrating a great potential for patient-specific investigations.

In conclusion, OCT may represent a reliable source for patient-specific CFD analyses which may be optimized using dedicated automatic segmentation algorithms.

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