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Titel des Beitrags: Non-standard bone simulation: interactive numerical analysis by computational steering

Abstract: Numerous numerical methods have been developed in an effort to accurately predict stresses in bones. The largest group are variants of the h-version of the finite element method (h-FEM), where low order Ansatz functions are used. By contrast, we investigate a combination of high order FEM and a fictitious domain approach, the finite cell method (FCM). While the FCM has been verified and validated in previous publications, this article proposes methods on how the FCM can be made computationally efficient to the extent that it can be used for patient specific, interactive bone simulations. This approach is called computational steering and allows to change input parameters like the position of an implant, material or loads and leads to an almost instantaneous change in the output (stress lines, deformations). This direct feedback gives the user an immediate impression of the impact of his actions to an extent which, otherwise, is hard to obtain by the use of classical non interactive computations. Specifically, we investigate an application to pre-surgical planning of a total hip replacement where it is desirable to select an optimal implant for a specific patient. Herein, optimal is meant in the sense that the expected post-operative stress distribution in the bone closely resembles that before the operation.