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Computational methods for assessing the forces transmitted to the cartilage microstructure of the lower limb during daily activities

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Osteoarthritis (OA) is a well-known joint disease caused by multiple factors such as aging, obesity, and overloading. Clinical experience has shown that movement is essential to prevent OA and slow its progression. However, recommendations, including those from the World Health Organization, mainly focus on reducing overuse and promoting a healthy lifestyle. The optimal frequencies and intensity levels of activity, which may vary based on age and health status, remain unclear. This uncertainty arises from the incomplete understanding of how loads are transmitted to the cartilage microarchitecture and how cells perceive them. This load estimation is essential for the development of biomaterials. Currently, there is a wealth of data on the dynamics of daily human activity and the mechanical behavior and properties of articular cartilage. Additionally, musculoskeletal and finite element models have seen significant advancements. The present challenge is to link these models at different scales. Therefore, the aim of this project is to develop a numerical tool that can merge a musculoskeletal model with a finite element model, thereby connecting the body scale to the tissue (and cellular) scale.

Master

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