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A PROTOTYPE MAGNETORHEOLOGICAL ELASTOMER FOR APPLICATION IN PROSTHETIC DEVICES

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Summary: One of the most important design goals of prosthetic devices is to provide the appropriate level of stiffness for the user. For example, high stiffness is required for tasks such as running and jumping, while low stiffness is required for walking or comfort while at rest. However, the components in a conventional prosthetic device generally have a fixed stiffness, regardless of the activity level of the user. Ideally, a device is wanted whose stiffness is controllable and adaptable to the user´s current activity. The aim of this research is to investigate the feasibility of MREs as spring elements in prosthetic devices, specifically their application in a prosthetic foot, whose properties adapt to the activity of the user. MRE samples are prepared using several carbonyl iron powder (CIP) isotropic and anisotropic particle distributions, all based on a polyurethane (PU) matrix. An experimental study is conducted, characterizing the static mechanical behavior of the samples, with a varying magnitude of the applied magnetic field. The design goals of a variable stiffness prosthetic foot are considered and compared to properties of the MRE samples. The results indicate that MREs are an attractive option for the construction of axial spring elements that can be of benefit in the construction of an active prosthetic foot. A design is proposed to integrate such an element into a carbon-fiber prosthetic foot, enabling real-time control of the foot, which means improved quality of life for the amputee.