Artificial vocalis muscles for speech synthesis made from contactless adaptable magnetorheological elastomer

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The adaptability of the properties of magnetic materials such as magnetorheological (MR) fluids, MR elastomers (MRE) and other magnetic hybrid materials drives scientific activities worldwide, trying to broaden the fields of application of such materials. In our work we focused on the utilization of MRE to realize an adaptive focal fold structure for a speaking machine. By introducing this novel material group into an artificial vocal tract it is possible to imitate the contraction of the vocalis muscle for voice formation.

In contrast to other approaches this solution initiates a very homogeneous adaption of the whole artificial vocalis muscle without intensely influencing the off state elastic properties of the material and without the necessity of a direct mechanical loading.

Alipour et al. [1] and Neubauer et al. [2] experimentally determined and characterized a strong mechanical anisotropy of different vocal tissues as the vocalis muscle or the lamina propria, identifying elastic moduli in for the latter of E_l = 30 kPa for longitudinal direction and of E_t = 1 kPa for transversal direction. Elastic properties of the same magnitude can be achieved with silicone elastomers. By using pre-structured MREs for artificial tissues it is possible to take into account this anisotropy while being able to continuously adapt the material's elastic properties. Therefore the introduction of field dependent materials such as MREs enables a technological change in speech synthesis.

In this work we manufactured, characterized and analyzed a variety of MREs based on different elastomer materials and filler particle contents to meet the reported elastic properties of the biological tissue and enable an adaptability of the elastic moduli. Experimental results of the MRE and voice samples generated will be presented at the conference.

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References

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