Title: Interactive Tangible Proxy Device with Reconfigurable Properties for VR/XR

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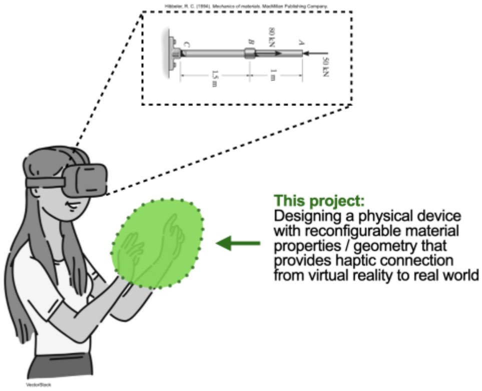
Description

Mechanics of materials concepts are taught primarily in a visual manner, with 2D diagrams and equations. However, we have five senses, so the ability to *feel* as well as *see* the effect of geometric/material property changes on mechanical behavior presents an opportunity for innovation. Advances in Extended Reality (XR) – the field encompassing a range of immersive experiences bridging the physical and virtual world – introduce new technologies for augmenting how teaching can be done with sight AND touch. Touch-based XR technology has been used for teaching magnetism, van der Waals forces [1] and buoyancy [2]. This project targets XR teaching opportunities for the subject “mechanics of materials,” focusing on designing a physical proxy for the real world with reconfigurable properties which will provide a tangible connection to a VR experience.



Goal

The intended “user” for this project is a student studying mechanics of materials. The key deliverable will be a device that the user can manipulate with their hands to develop an intuition for the relationship between geometry (such as cross-sectional shape) or material properties (such as Young’s modulus), and mechanical behavior. These properties must be easily adjustable to allow the user to experience a variety of different scenarios. The device will be passive in the sense that any actuation will come from the user interacting with the device through touch. Developing the software for the VR experience is not in the scope of the project: this project focuses on developing the physical device.

Approach

Start from the user’s perspective and consider their requirements. Consider different reconfigurable mechanisms/topologies which can be used to manipulate the user’s perception. Establish metrics for evaluating each option. Initial testing of rough prototypes will be followed by construction of a refined device. Successful projects can lead to larger collaborations with VR software researchers in the future.

References

[1] Park, J., Doxon, A. J., Provancher, W. R., Johnson, D. E., & Tan, H. Z. (2012). Haptic edge sharpness perception with a contact location display. IEEE Transactions on Haptics, 5(4), 323–331.
[2] Sanchez, K. L., Magana, A. J., Sederberg, D., Richards, G. P., Jones, M. G., & Tan, H. Z. (2013). Investigating the impact of visuohaptic simulations for conceptual understanding in electricity and magnetism. In 2013 ASEE annual conference & exposition (pp. 23–831).