A SETUP FOR ASSESSING THE ACCEPTANCE OF VIBRATIONS TO IMPROVE FOOTBRIDGE DESIGN

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Summary

To improve the design of lightweight footbridges, there is a growing interest in pedestrian induced vibrations and their impact on the bridges' structural response as well as their implication for human usability.

While current regulations provide reasonable guidelines there is still a lack of systematic studies that include empirical assessments of different user's parameters with respect to their influence on bridge vibration acceptance.

In this paper, we present our novel setup and exemplary assessment designs to evaluate human acceptance of vibrations depending on footbridge parameters (e.g. height, width, stiffness, etc.).

The setup consists of a platform supported by six pneumatic actuators. With these we can induce vibrations similar to those pedestrians induce to lightweight footbridges.

This setup is completed by a virtual reality environment (VR) experienced by the user via a head-mounted display (HMD). The virtual environment includes a visual representation of a pedestrian bridge, which mirrors the vibrations of the platform in real-time. This setup allows us to manipulate the bridge related parameters experienced by the user, e.g., the bridges' structural height and width, as well as the virtual surroundings of the bridge. In addition, the platform is designed to be equipped with multiple force plates, allowing for evaluating the ground reaction forces between the user and the structure. Combined with additional biomechanical gait data (e.g. joint kinematics, muscle activation etc.), we obtain a comprehensive image of the pedestrians' physical responses. This will help us to further understand the dynamical interactions between the human and the footbridges.

In our paper, we give provide detailed information on our setup, and explain how users' reaction on different bridges can be tested. We explain how the user's behaviour, emotions and motor reactions can be measured to obtain valuable insights into the human's response towards vibrations.

Keywords: Architecture experience; Bridge engineering; Comfort; Dynamics; Human structure interaction; Serviceability; User experience; Vibrations

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