

Development of a Virtual Reality Excavator Simulator: a Mathematical Model of Excavator Digging and a Calculation Methodology

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Abstract

Virtual Reality (VR) simulators have become popular because of two distinctive merits. One is the capability to transfer data and information to users in an intuitive way by means of 3-D high-quality graphics output and real input devices. The other is the capability to represent physical systems in mathematical models so that meaningful responses of the systems can be predicted. Previous efforts in VR excavating machine simulator development, however, showed a lack of balance between the fidelity of the model of the physics and the visual representation of the simulated equipment.

In order to ensure that a VR construction excavator simulator provides convincing operating results to users, the focus of simulator development needs to be shifted to interaction of physically valid soil and the excavator machine.

This research aims to contribute to the development of a VR construction excavator simulator system by proposing a mathematical model of excavator digging and a calculation methodology. The mathematical model of excavator digging provides physically meaningful soil-bucket interaction information to a simulator. The calculation methodology provides systematic and efficient computation methods to ensure the seamless integration of the excavator digging model with a VR simulator system as well as adequate system speed. As a result, the simulator is realized as an engineering process tool equipped with real-time interactivity.