Master thesis projects in Digital Physics

About Digital Physics

Digital Physics is the art and science of creating virtual environments that evolve according to physical laws of motion. This enables safe and controlled experiments with machines and solutions not yet created. Simulation is essential for developing AI-based perception and control that requiring large sets of (synthetic) training data. The research group is devoted to the underlying computational science, primarily realtime physics of contacting multibody systems, and to explore new ways of using digital physics, for instance autonomous vehicles and robots manipulating their physical environment.

For further information: digitalphysics.se

Available projects

Two similar projects are proposed. Two students working on one project each can share lots of ideas and technical solutions. Simulators and control algorithms are available from previous and on-going research projects. The projects may involve collaboration with other partners such as Algoryx, Komatsu, SCA, and UC Berkeley.

Predicting grippability. Consider a disordered pile of logs to be loaded using an automated mechanical gripper. In which order should the logs be loaded to minimize the total energy use, time, and risk of failure? Where and how should the gripper be applied, avoiding grasping too many logs or trying to lift logs that are stuck? The ground truth can be found using physics-based simulation and synthetic camera data. The task is to generate large ground truth datasets and develop a model for predicting optimal gripping locations using machine learning.

Predicting diggability. An autonomous wheel loader digging into a pile of granular material should carefully adapt its point of attack and bucket motion to the shape of the pile and the material, e.g., gravel, sand, or coarse rock. A poor dig plan may waste a lot of energy and time and may damage the equipment. The best strategy can be explored using physics-based simulation, which also support generation of synthetic camera data for the pile before digging into it. Combining these data sources, it is possible to produce a model for predicting optimal dig plans.

Prerequisites

A specialization in computational science and engineering is necessary - in particular physics-based simulation, statistics, and machine learning. Programming and data analysis using Python is important. Knowledge in and experience of computer vision, robotics, physics engines, and Unity 3D, is meriting.

Contact

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