ETH zürich

Licensing Opportunity

Real-time user feedback from unpredictable data streams

Summary

The invention relates to the field of computational methods for providing real-time feedback from states of a model physical system where the calculation of these states is of unpredictable duration. It was developed to enable interactive simulations of molecular systems based on quantum mechanics with force-feedback enabled input devices.

Background

Interactivity is key to the immersion of users into virtual worlds reflecting real physical systems. In many fields computations for a reliable feedback have long and/or unpredictable durations that prohibit meeting any hard real-time requirement. For instance, in many physical systems the interaction of many components (fluid dynamics, molecular systems, raytracing etc.) must be calculated in an iterative and/or sequential way resulting in unpredictable durations. More generally, in any virtual exploration scenario the temporary unavailability of data may prevent or impair true interactivity.

Invention

The present innovation is a computational method that comprises continuously receiving inputs from a user interface, updating the configuration of the model physical system and calculating its states. Then a surrogate function is constructed from the results approximating the real state of the system. The surrogate acts as a temporary mediator between user and computation and is designed to be quickly evaluated for each configuration sampled by the user input. This enables quasi-instantaneous responses for true interactivity even if the computation of the true state would prevent it, independent of the complexity and/or unpredictability of the computation. Still, the surrogate function is constructed from a rigorously computed state of the system and is refreshed continuously to maintain sufficiently high fidelity.
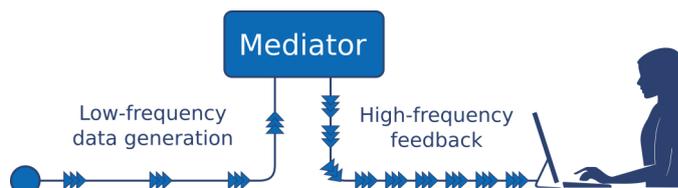

Fig. 1 A surrogate function (mediator) of the true state of a physical system provides a real-time response even when the computation of the true state does not meet any real-time requirements.

Features & Benefits

- Meets real-time requirements in scenarios with unpredictable data sources
- Provides constant feedback by a surrogate function
- Gives conservative feedback keeping the user in trusted regions around the last valid computation

Fields of Application

- Teleoperation scenarios where feedback is generated from sensor data of unpredictable availability (e.g. drones, unmanned submarines, vehicles, drills)
- Visual exploration scenarios where the visualization is based on varying amounts of data depending on the user's exploration as, e.g. in raytracing of complex environments
- Interactive exploration of systems with many, interacting components such as molecules

Patent Status

- Patent pending

Publications

- Vaucher A.C., Haag M.P., Reiher M., "Real-time Feedback from Iterative Electronic Structure Calculations", *J. Comput. Chem.* **2016**, 37(9), 805-12

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