PHYSICSFORESTS: REAL-TIME FLUID SIMULATION USING MACHINE LEARNING

Real-Time Live!

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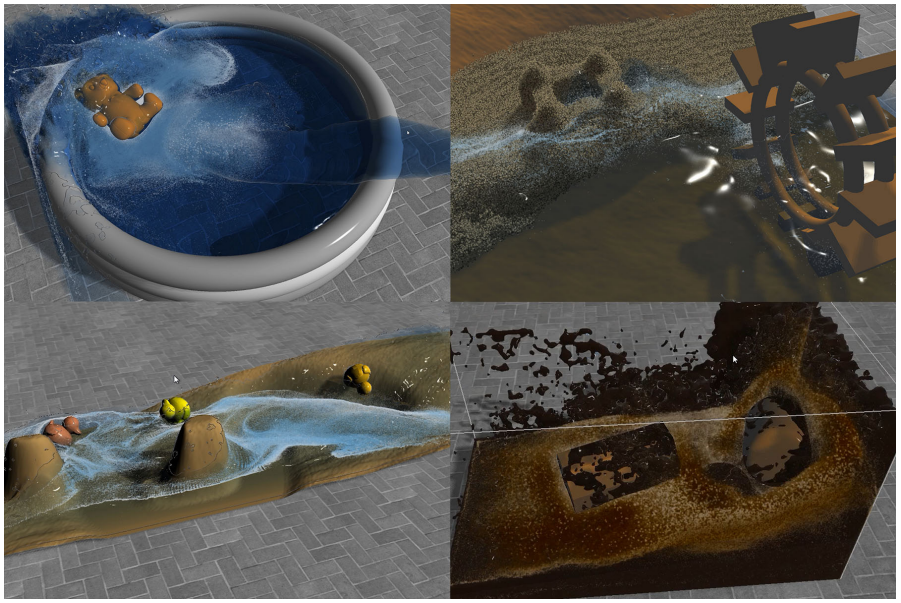

PhysicsForests is a fluid-simulation framework that can simulate large scenes with several million particles in real time, including surface generation, foam, rigid-body coupling, and rendering. Instead of solving underlying Navier-Stokes equations, it predicts particle behavior approximately using machine-learning–based regression-forest method that is trained on a large set of randomly generated scenes obtained by a traditional fluid solver. The result is faster and more stable than standard methods. The simulation does not diverge even if the incompressibility constraint cannot be satisfied, for example in case of an extremely aggressive impact caused by user interaction. The parametric-input feature vector allows for simulation of a wide range of materials, differing in density, viscosity, static friction, or surface tension, and coupling of fluids with rigid bodies or with each other.

The surface is generated in a similar fashion by predicting the signed distance field with another regression forest using the same shared-feature vector, leading to only a small overhead in simulation time. Foam particles are created near the surface with velocity discontinuities and advected along the predicted velocity field, and they disappear after a predefined period of time. The scene is rendered using a standard screen-space approach. The method can handle a wide range of fluid parameters and is suitable for real-time applications, such as computer games or interactive design.

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