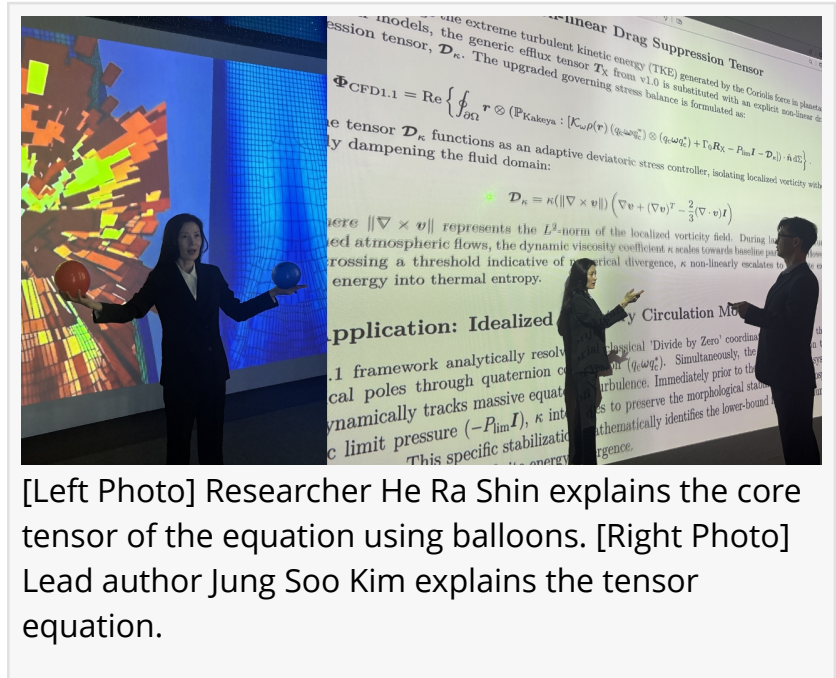


Official Release of Research Paper on H.U.G.G.E.R v1.1 Tensor Controlling Complex Fluid Turbulence

Features a non-linear drag suppression module, offering a fundamental solution to prevent computational blow-ups in climate and aerospace simulations.

IFEZ, INCHEON, SOUTH KOREA,
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EINPresswire.com/ -- Lead author Jung Soo Kim and researcher He Ra Shin officially published the H.U.G.G.E.R (Heuristic Universal Grid and Gravity Equilibrium Rendering Tensor) v1.1 framework on global academic archives and open source platforms on the 9th. This framework mathematically and smoothly stabilizes the computational delays and paralysis that occur when simulating dynamic atmospheric fluids like typhoons.



[Left Photo] Researcher He Ra Shin explains the core tensor of the equation using balloons. [Right Photo] Lead author Jung Soo Kim explains the tensor equation.

Currently, existing 3D fluid dynamics simulations (Navier-Stokes based) widely used by meteorological agencies and industries worldwide frequently suffer from blow-up phenomena. When calculating the Coriolis force from Earth's rotation or extreme turbulence, they fall into coordinate singularities (Divide by Zero), causing data to explode infinitely.

The core technology revealed in this v1.1 update paper is the non-linear drag suppression tensor module, which controls turbulent energy that escapes manageable ranges. This equation regulates macroscopic fluid flows through two key mechanisms.

First is Extreme Limit Pressure Detection and Equilibrium Control. To prevent system computation from halting, the maximum allowable limit pressure tensor of the fluid is embedded in the equation. Just before the energy crosses the critical threshold, it naturally dissipates the excess energy as heat, effectively preventing hardware overload.

Second is Structural Optimization of Local Vorticity. Without suppressing the entire flow, it locally isolates only the explosively rotating vortices, minimizing numerical errors so the computer can calculate most stably.

Jung Soo Kim explained, "Natural atmospheres and fluids do not expand infinitely and collapse like mathematical limit points, but possess the characteristic of finding equilibrium on their own." He added, "By smoothly tuning the geometric structure of these macroscopic fluids, the H.U.G.G.E.R framework overcomes the limitations of existing computational methods and aims to provide engineers worldwide with an absolute computational tool that does not collapse."

Researcher He Ra Shin likened this principle to a familiar smart balloon. "If the existing method is like blowing air into a balloon endlessly until it eventually bursts and stops the simulation, our equation is like a smart valve that senses the pressure right before the balloon bursts and smoothly disperses the energy," she added.

This innovative mathematical framework contributes to safely preserving the public's lives and daily routines. This technology, which peacefully controls the massive flows of air and water, is expected to bring positive changes to the following areas.

One area is Protecting Lives and Property by Improving Climate Prediction Accuracy. It reduces instances of computer crashes during simulations of extreme weather anomalies like massive typhoons. By seamlessly and precisely predicting complex weather changes, it contributes to protecting humanity from disasters.

Another area is Advancing Safe and Eco-friendly Aviation and Marine Technologies. It intricately simulates the process of airplanes or next-generation ships overcoming severe turbulence and air resistance within a computer. By reducing friction energy, this serves as a solid foundation for various industries dealing with water and air flows, from designing deep-sea submersibles that withstand extreme water pressure to eco-friendly wind power generation, to continuously develop beyond computational limits.

The final area is Computational Independence and Cost Reduction for Small Labs. It innovatively alleviates the heavy computational simulation loads that were previously concentrated in heavily-funded supercomputers. Thanks to this framework controlling computational blow-ups, startups or independent researchers with limited budgets and equipment can now rapidly and stably perform macroscopic gravity fluid simulations using just their standard workstations.

This gravity fluid paper has been released to everyone via the Zenodo academic archive and Hugging Face repositories. Industry experts operating large-scale simulation environments, as well as anyone worldwide researching next-generation fluid control technologies, can download the formulas from this paper to begin immediate verification and applied research.

Jung Soo Kim

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