Complex currents and repetitive patterns

Many complex currents exhibit repetitive behavior, such as the formation of bubbles in the giant reactors of the chemical process industry - in which polymer particles are churned and mixed - or the turbulent vortices of liquid steels in so-called strand casting facilities.
The simulation of such large, complex systems is extremely time-consuming, but provides valuable information on their characteristics. Dr. Thomas Lichtenegger has developed methods with which rapid and efficient insight into these processes can be obtained.

“You can imagine a pot full of boiling water, in which air bubbles are rising. You get the impression that the pattern of rising bubbles repeats itself,” says Lichtenegger. It is these repetitive patterns in dynamic systems that he attempts to find, and to learn from their progression.

The simulations currently in common use can only depict large-scale currents for a few seconds. Lichtenegger’s goal is, however, to enable them to be portrayed for longer periods of time.“In the LIT project, we will probably not be able to achieve real-time capability,” he says. “But we will show that, with our method, we have developed a powerful tool that can speed conventional simulations by a factor of 100 to 1000.”

In principle, alongside industrial applications, Lichtenegger also sees possibilities in other areas where currents with repetitive behavior are found. The methods developed can be applied to such diverse areas as bloodflow in the human heart, the spread of fine particles in the atmosphere or sedimentary behavior in rivers.

Publications:

T. Lichtenegger, E.A.J.F. Peters, J.A.M. Kuipers and S. Pirker. "A recurrence CFD study of heat transfer in a fluidized bed." accepted by *Chemical Engineering Science* (2017)

T. Lichtenegger and S. Pirker. "Extremely fast simulations of heat transfer in fluidized beds." in: *12th International Conference on CFD in the Oil & Gas, Metallurgical and Process Industries* (2017)

T. Lichtenegger and S. Pirker. "Recurrence CFD–A novel approach to simulate multiphase flows with strongly separated time scales." *Chemical Engineering Science* 153 (2016): 394-410.

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