FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

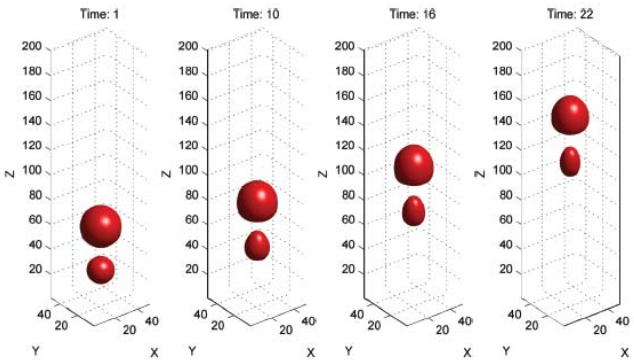
U.S. DEPARTMENT OF ENERGY

PROJECT FACT SHEET

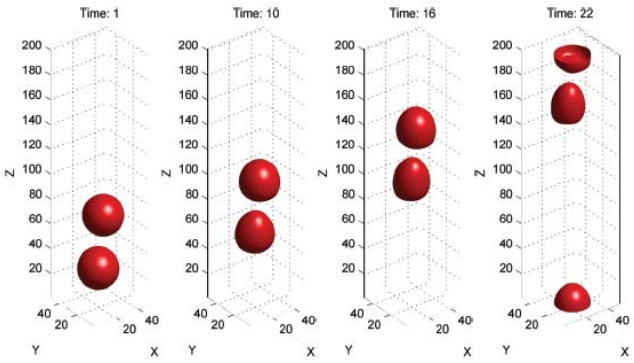
Multiple-Relaxation-Time Lattice Boltzmann Model for Multiphase Flows in Three Dimensions

FIU's Applied Research Center is assisting the Department of Energy's Hanford Site by developing a computational program based on the lattice Boltzmann method in order to generate computer simulations of engineering problems involving multiphase flows.

The production of plutonium at DOE's Hanford Site during the cold war has resulted in millions of gallons of radioactive waste stored in various sites across the U.S. The waste exists in the liquid and solid form and kept in underground tanks some of which have been detected to leak due to the mechanical degradation and aging of the tank walls. The waste is being transferred to double shell tanks which are more leak-resistant and various waste retrieval and processing methods are employed during this process. Mixing of the liquid-solid waste in the tanks using pulsed-jet mixers coupled with air spargers is one of such operations that requires understanding the physical nature of the interaction of multiple fluid phases in the tank environment in order to optimize the mixing effectiveness considering various waste properties. Such an analysis can be made possible by developing a numerical method that can simulate the process of injection of gas and liquid jets inside tanks filled with liquid.



3D MRT LBM simulation of two unidentical bubbles rising.



3D MRT LBM simulation of two identical bubbles rising misaligned initially.

Project Objectives

The overall objective of this project is to develop a computational program that can be used as a numerical tool at DOE Sites in order to investigate and understand the physics of multiphase fluid flows that occur during mixing in waste tanks, gas generation in wastes, etc. The software that will be produced at the end of this task can be used as a virtual experiment environment that will complement experimental data for various scenarios of flow conditions and fluid properties.

Project Benefits

Benefits of developing MRT LBM software for multiphase flows are:

- Reduce the cost and time for conducting extensive experiments on multiphase flows.
- Provide quick, accurate and detailed flow field information for design optimization and problem mitigation for multiphase flow applications.

Project Accomplishments

- Developed a multi-phase MRT LBM software in two and three dimensional domains with the capability of using parallel computing.
- Verified the multi-phase MRT LBM software and simulated evolution of static and dynamic bubbles in multiphase fluid flow cases.

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