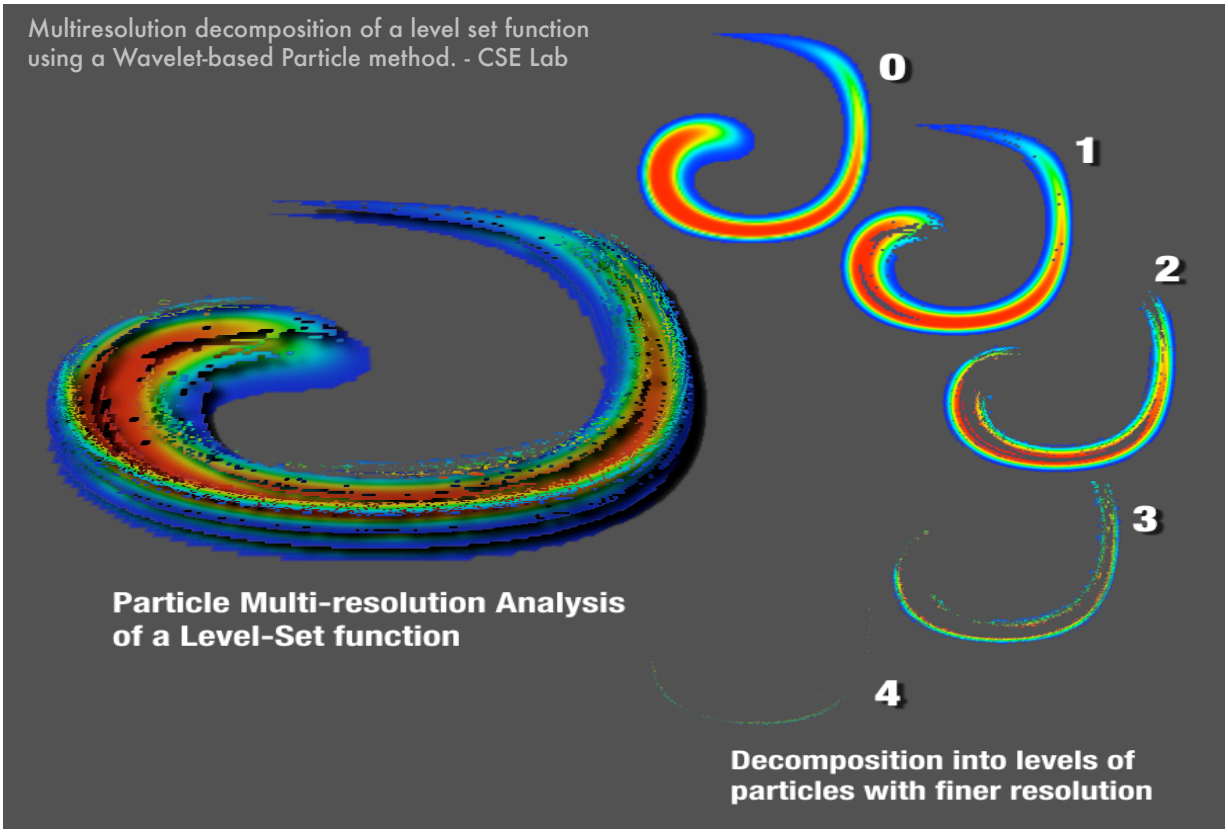
Master Thesis

INSTITUTE OF COMPUTATIONAL SCIENCE



Parallel Wavelet Particle Method

Parallelization of an adaptive wavelet-based particle method interfacing with an object oriented block-structured grid based method (AMROC)

The simulation of transport phenomena by any numerical method poses the following problem: The convective term in the governing equations generates a broad range of length scales. This range of length scales needs to be accounted for by either: (i) Modeling: the effect of small scales on coarse scales is modeled and only coarse scales are represented by computational elements (grids, particles). (ii) Resolving: all length scales are resolved by the computational elements. Using a non-adaptive numerical method leads to a prohibitive computational cost. We have therefore developed a wavelet-based particle method that adaptively represents different length scales.

The goal of this thesis is to embed this wavelet-based particle into a framework that is easy to use and parallel. This framework will make heavy use of the memory-adaptive, parallel data structures provided by the Adaptive Mesh Refinement (AMR) library AMROC (amroc.sourceforge.net). The work on this project involves the development of an interface between the two codes.

PREREQUISITES

Programming skills in Fortran 90
Proficiency in C++
Interest in state-of-the-art numerical methods.

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CSE LAB

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In the CSE Lab we combine computational methods, computer science tools, and domain specific knowledge to solve scientific and Engineering Problems in areas such as Fluid Mechanics, Nanotechnology and Life Sciences. The core computational competences of our group are in particle methods and in stochastic optimization techniques. Motivated by challenges in application fields, we focus on identifying the common elements among computational techniques and on formulating common methodological, algorithmic and software structures that facilitate their further development.