

BUILDING UPON FAST MULTIPOLE METHODS TO DETECT AND MODEL ORGANIZATIONS

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Abstract. Many models in natural and social sciences are comprised of sets of interacting entities whose intensity of interaction decreases with distance. This often leads to structures of interest in these models composed of dense packs of entities. Fast Multipole Methods are a family of methods developed to help with the calculation of a number of computable models such as described above. We propose a method that builds upon FMM to detect and model the dense structures of these systems.

Keywords. Organization detection, structure management, multiscale, N body systems, hierarchical tree code approximations.

1 Introduction

We study in this paper dynamic systems composed of many interacting entities. We are interested in their modeling, simulation, in the way they evolve and organize themselves.

Among these theoretical systems, a class of them is used as models for different natural science systems. In this class, systems verify the following properties:

1. Entities follow an analytical model.
2. Each entity interacts with all the others.
3. The strength of the interactions decreases with the distance separating the entities implied in the relationship.

It is to this class that N-Body problems in physics belong to for example.

Property 2 makes computing a simulation through the iterative calculations of the model in 1 costly, in $O(n^2)$ for n entities. There are mathematical