CoMFoS-NASC International Conference 2026
20–23 June 2026 | Lapu-Lapu City, Cebu, Philippines 6015
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Efficient Numerical Algorithm for Solving c-transform on Quadtree and Octree Meshes

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The back-and-forth method can be used as a solver for partial differential equations (PDEs) that can be expressed as a gradient flow of the Wasserstein distance [1]. These include many important moving boundary problems like the porous medium equation or the Hele-Shaw problem. The c-transform $\phi^c(x) := \inf_y c(x,y) - \phi(y)$ plays an important role in the back-and-forth method [2]. In this talk, we propose an algorithm for numerically solving the c-transform on quadtree and octree meshes. The use of quadtree and octree improves computational efficiency while maintaining high accuracy by subdividing only regions which require higher resolution.
Our algorithm uses monotonicity of quadratic cost $c(x,y) = \|x-y\|/2$ and recursive way that exploits the hierarchical data structure of quadtree and octree. Consequently, the computational complexity of the algorithm is $O(N \log N)$ where N is the number of nodes.

Keywords: optimal transport, the back-and-forth method, quadtree and octree, numerial algorithm, computational compexity

MSC2020: 65M50, 65Y20, 49Q22

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