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**Multi-Level Optimization for Image Registration using
Local Refinement on Octrees**

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We present a new multi-level approach for non-linear image registration using local refinement techniques.

Standard multi-level approaches for this problem discretize the domain starting with a regular coarse grid and refine every cell from level to level. In our approach, we also start with a regular coarse grid but its refinement for higher levels is done locally. Using local refinement is motivated by the observation that changes in the solution at higher levels appear mainly locally and large areas stay unchanged such that there is no need for a finer resolution. The local refinement in our approach is done by subdividing cells into four (2D) or eight (3D) resulting quad (2D) and octree-grids (3D), respectively.

Compared with the standard multi-level approach, our method requires substantially less memory and arithmetic operations. Therefore, it is in particular well-suited for large-scale problems.