SURFACE RECONSTRUCTION FROM POINT CLOUD USING A SEMI-LAGRANGIAN SCHEME WITH LOCAL INTERPOLATOR

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We propose a level set method to reconstruct unknown surfaces from point clouds, without assuming that the connections between points are known. This issue is particularly relevant in the field of cultural heritage where it is common to have a set of unorganized points obtained via laser scanning techniques as input data to model the shape of a work of art, both for visualization purposes and for further investigations. From a mathematical point of view, the problem follows a variational and partial differential equation (PDE) formulation with a curvature constraint that minimizes the surface area weighted by the distance of the surface from the point cloud. Level set methods are used in this framework to track the evolution of an initial surface and to find an implicit representation of the final shape. Among all the possible representations, we compute the signed distance function at least in the vicinity of the reconstructed surface. The numerical method for the approximation of the solution is based on a semi-Lagrangian scheme whose main novelty is its coupling with a local interpolator, with the aim of saving computational costs, considering in particular a multi-linear interpolator and a WENO one to improve the accuracy of the reconstruction. Special attention has been paid to the localization of the method and to the development of fast algorithms that run in parallel, resulting in faster reconstruction and thus the opportunity to easily improve the resolution. A preprocessing of the point cloud data is also performed to set the parameters of the method in a suitable way. Numerical tests in two and three dimensions are presented to evaluate the quality of the approximated solution and the efficiency of the algorithm in terms of CPU times.