Dynamic Contour Modeling of Wet Material Objects by Periodic Smoothing Splines

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Wet material objects – such as jellyfish, red blood cell and amoeba, etc. are characterized by various deformation motion. One of important issues in their studies is to analyze and understand the motions of such objects from the observational data, e.g., some image frames in a movie file. Then, the contour modeling of deformable objects plays key roles, and has been studied in the field of image processing – such as active contour model. However, most of the approaches have focused their attention on the problem of modeling the contour of objects at some time instant. Thus, there are difficulties when we analyze and understand a whole motion of the moving deformable objects, e.g., wet material objects. In this study, we present a new scheme for modeling the contour of wet material objects by employing optimal design of periodic smoothing spline surfaces. The surfaces are constructed using normalized uniform B-splines as the basis functions, namely as weighted sum of sifted bi-variable B-splines. Then a central issue is to determine an optimal matrix of the so-called control points. By employing such a B-spline approach, a concise representation for the optimal surfaces with periodic constraint is derived, which has the additional merit of lending itself to the development of computational procedures in a straightforward manner. Moreover, it is shown that additional equality and/or inequality constraints can readily be incorporated into the periodic surfaces. The results are applied to the problem of modeling contour of wet material objects with deforming motion, and the effectiveness is examined by numerical and experimental studies.

Keywords: B-splines, optimal spline surface, motion understanding, moving deformable objects