

Lee, Eunjung; Gunzburger, Max**Analysis of finite element discretizations of an optimal control formulation of the image registration problem.** (English) [Zbl 1254.65036](#)

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Image registration is the process of transforming different sets of images into one coordinate system and it has been used in a wide variety of applications such as medical imaging, remote sensing and computer vision to name a few. In this task, the differences between images are introduced due to different imaging conditions such as multiple images from different sensors, from different times, or from different viewpoints. The aim of image registration is to find a geometric transform such that the transformed template image becomes similar to the reference image.

Using the grid deformation method introduced by *G. Liao, T.-W. Pan* and *J. Su* [Numer. Methods Partial Differ. Equations 10, No. 1, 21–31 (1994; [Zbl 0801.65115](#))] and by *P. Bochev, G. Liao* and *G. dela Pena* [ibid. 12, No. 4, 489–506 (1996; [Zbl 0856.65109](#))], a novel optimal control formulation for the image registration problem has been proposed by *E. Lee* and *M. Gunzburger* [J. Math. Imaging Vis. 36, 69–80 (2010)]. This is the first numerical scheme based on the grid deformation method for the image registration problem.

In this paper, the authors continue the work of *E. Lee* and *M. Gunzburger* [loc. cit.] to define finite element discretizations of the optimal control formulation and to provide a rigorous mathematical analysis of convergence of the approximate solutions. Furthermore, for practical purposes, the authors introduce a gradient method to simplify their finite element discretizations by uncoupling the components of the discretized optimal control formulation and show the convergence of that iterative method.

Reviewer: [Wang-Q Lim \(Berlin\)](#)**MSC:**

- [65D18](#) Numerical aspects of computer graphics, image analysis, and computational geometry
- [94A08](#) Image processing (compression, reconstruction, etc.) in information and communication theory
- [49M05](#) Numerical methods based on necessary conditions
- [49J20](#) Existence theories for optimal control problems involving partial differential equations
- [65K10](#) Numerical optimization and variational techniques

[Cited in 5 Documents](#)**Keywords:**[image registration](#); [finite element methods](#); [optimal control](#); [gradient methods](#); [medical imaging](#); [remote sensing](#); [computer vision](#); [grid deformation method](#); [convergence](#)**Full Text:** [DOI](#)