Non-rigid Registration of De-noised Ultrasound Breast Tumors in Image Guided Breast-Conserving Surgery

Sanjib Saha

Abstract It's an article based on medical ultrasound-to-ultrasound non-rigid registration of breast tumors in image-guided surgery. Firstly, the paper discusses the challenges behind ultrasound image registration. Secondly, the paper establishes scan conversion using Lee filters along radial as well as horizontal directions depending on the minimum mean square error (MMSE) is a reasonable choice to convert signal-dependent or pure multiplicative noise to an additive one and that produces speckle free ultrasound image. This paper also introduces unique aspects of the registration framework for non-rigid (elastic) deformations and presents a novel non-rigid registration associated with a unique basis function where each local control point strikes the deformed structure of the curve over the range of criterion values. Piecewise cubic polynomial form splines (B-splines) are used to get the distortion field among two ultrasound images and one of the popular similarity measure criteria on sum of squared difference (SSD) is used to find the dis-similarity among monomodal images. The line search approach of the Quasi-Newton Limited-Memory (LM) Broyden–Fletcher–Goldfarb-Shanno (BFGS) algorithm is used to optimize the dissimilarity errors. Thirdly, this proposed work for non-rigid registration is applied in breast-conserving surgery of breast tumors between pre-operative and intra-operative ultrasound. This novel approach is computationally efficient.

Keywords Non-rigid registration · Ultrasound image registration · Breast tumor · Image guided surgery

1 Introduction

Image registration aligns two images i.e., the reference image and the test image. The images taken by various sensors or at the various time or from various views are to be compared when a small sub-portion of the image needs to be searched in

S. Saha (✉)

Department of Computer Science and Engineering, Dr. B. C. Roy Engineering College, Durgapur, India

e-mail: sanjib.saha@bcrec.ac.in