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研究论文

LBM的医学影像非刚体配准新方法

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摘要：

为了提高医学影像的配准性能，利用流体粒子运动可以模拟任意自由复杂形变的特性，将医学影像配准问题转化为粘滞流体力学物理问题，提出了一种基于离散格子玻耳兹曼方法(LBM)的非刚体配准新方法．配准过程是把浮动影像、目标影像和浮动影像的灰度差以及像素点分别视为粘滞流体、外力以及流体粒子，通过LBM方程模拟浮动影像像素点在外力作用下的流动，使影像产生位移场，发生形变．当两幅影像的灰度值接近一致时，外力消失，流体流动停止，影像达到配准．建立了含外力项的粘性可压缩LBM方程，并对边界条件、初始条件和速度模值进行了定义．实验结果表明，文中方法与同类方法相比，配准性能得到了全面提升，提高了配准效率，适合大形变配准场合．

关键词： 生物影像处理 格子玻耳兹曼模型 医学影像 非刚体配准 粘滞流体

Non-rigid registration method of the medical image based on the LBM

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Abstract:

In order to improve the overall performance of medical image non-rigid registration, this paper presents a new medical image non-rigid registration method based on the LBM (Lattice Boltzmann Method). Firstly, this paper transforms medical image registration into a viscous fluid physical problem to take advantage of the fact that fluid particle movement can simulate any free complicated deformation. In the registration process of this paper, floating image, the gray level difference between the template image and the floating image, and image pixels are considered as a viscous fluid, external force and fluid particle, respectively. The external force from the gray level difference between the template image and the study image drives registration. Through simulation by use of the LBM, the flow of template image pixels under the external force which make the template image generate displacement field and deformation is obtained. When the gray scale values between the study image and the template image are near agreement the image registration has finished, at which time the external force disappears and the fluid flow stops. The LBM equation of the compressible viscous fluid with the external force is set up. In addition, the boundary conditions, initial conditions and speed module value are defined in this paper. Experimental results show that the non-rigid medical image registration performance has been improved comprehensively and especially the efficiency of image registration has a qualitative leap. This method is very suitable for large deformation registration occasions.

Keywords: biological image processing Lattice Boltzmann method medical image non-rigid registration viscous fluid

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