TWO DIMENSIONAL ACTIVE CONTOUR MODEL ON MULTIGRIDS FOR EDGE DETECTION OF IMAGES

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To my family, thanks for the never ending love.

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ABSTRACT

Low-level tasks have been widely regarded as autonomous bottom-up processes in computational vision research. Examples of low-level tasks are edge detection, stereo matching, and motion tracking. In medical imaging, active contours have also been widely applied for various applications. In fact, active contours is one of the most popular PDE-based tools and powerful tool in performing object tracking. Active contour model, also called classical explicit snake was first introduced by Kass, Witkin and Terzopoulos. The main weaknesses of this method relate to not only the intrinsic characteristics of the contour, but also the parameterization, in which it is unable to handle topological changes. To solve these problems, a different model for active contours based on geometric partial different equation is proposed which is independent of parameterization, intrinsic and very stable. The important development has been the introduction of geodesic active contours. Level-set method was introduced for the moving fronts capture, where the active contour method is given implicitly as the zero level-set of a scalar function defined on implementing the entire image domain. This allows for a much more natural changes in the topology of the curve than parametric snakes. However, the main weakness of level set methods is that the complexity of the computational cost is high. A fast algorithm using semi-implicit addictive operator splitting (AOS) technique is used to restrict the computational cost. Edge detection based on semi-implicit is implemented for the edge detection on medical images such as medical resonance image (MRI). Multigrid is a numerical method that has a good accuracy and stability even with big time step. Exploiting these properties, multigrid was adopted for implementation of the geodesic active contour model. MATLAB has been chosen as the development platform for the implementations and the experiments since it is well suited for the kind of computations that are required. Besides it is widely used by the image processing community. Experimental results demonstrate the multigrid is the most appropriate method that can applied with AOS implementation for medical imaging to detect the location of the tumor which can decrease number of iterations.

ABSTRAK

Tugasan aras rendah digunakan secara meluas sebagai proses berautonomi bawah ke-atas dalam kajian penglihatan perkomputeran. Beberapa contoh tugasan aras rendah ialah seperti pengesanan pinggir tepi, pemadanan stereo, dan penjejakan gerakan. Kontur aktif juga telah banyak digunakan dalam pelbagai aplikasi seperti imej perubatan. Salah satu alat berasaskan PDE adalah yang paling popular dalam perlaksanaan penjejakan objek. Kontur aktif model juga dinamakan kaedah klasik tidak tersirat yang pertama kali diperkenalkan oleh Kass, Witkin dan Terzopoulos. Kelemahan kaedah ini tidak hanya bergantung pada sifat hakiki kontur tetapi juga pada parameter. Ia tidak boleh dikendalikan dalam perubahan topologi. Dalam mengatasi masalah ini, model yang berbeza telah diperkenalkan untuk kaedah kontur aktif berdasarkan persamaan geometri berbeza separa. Kaedah ini mempunyai parameter bebas, intrinsik dan stabil. Kontur aktif geodesik telah menjadi suatu pembangunan yang penting. Kaedah set paras merupakan kaedah tangkapan gerakan terkehadapan, di mana kontur aktif secara tersirat diperkenalkan sebagai set paras sifar fungsi skalar tersembunyi dan dianggap sebagai domain keseluruhan imej. Perubahan dalam topologi yang lebih melengkung secara semulajadi dibenarkan berbanding kaedah kontur aktif tradisional. Namun, kelemahan utama kaedah set paras ialah kos pengiraan sudah cukup tinggi. Algoritma pantas ialah satu teknik pemisahan agihan separa-tersirat (AOS) digunakan untuk mengurangkan kos pengiraan. Pengesanan sempadan tepi berdasarkan separa tersirat mampu mengesan sempadan tepi pada imej perubatan seperti pengimejan resonans magnetik (MRI). Multigrid adalah suatu algoritma dalam kaedah berangka yang mempunyai ketepatan dan kestabilan yang lebih baik walapun dalam langkah masa yang besar. Berdasarkan sifat ini, kaedah multigrid dilaksanakan dalam melaksanakan kontur aktif geodesik. Perisian MATLAB dipilih sebagai platform pembangunan kerana ia sesuai untuk semua pengiraan yang diperlukan. Malah ia digunakan secara meluas dalam komuniti imej pemprosesan. Daripada hasil kajian menunjukkan kaedah berangka paling baik untuk dilaksanakan bersama AOS untuk mengesan lokasi tumor dalam bidang imej perubatan dimana ia mengurangkan bilangan lelaran.