**Abstract**

Self-similarity is a key ingredient in discovering the structure of functions. Fourier transforms, fractals, Gabor analysis and wavelets are state-of-art techniques in the multiresolution representation of self-similarity. These will be studied and compared in the findings of feature vectors for image analysis. The goal is to mimic and analyze human perception with advanced mathematical and statistical tools. For the represented feature vectors of large volume data in high dimension that occur in image analysis, dimension reduction without loss of intrinsic information is important to preserve the geometric structure and make computation feasible. Principal component analysis (PCA), independent component analysis (ICA), sliced inverse regression (SIR), classification and regression trees will be integrated with self-similarity techniques in the clustering, classification, segmentation and pattern recognition of images. A general framework and methodology are aimed at this stage. Finally, these new techniques will be combined with expertise information to statistical data mining in medical images. That is, the medical expertise will be converted into statistical tests and decisions. These developments lead to objective and automatic decisions, which will be compared with the diagnosis results by medical expertise to find out the effectiveness. At the end, new and effective
statistical methods for image analysis will be proposed and investigated to assist the medical diagnosis of medical images in this long-term project. The medical images will include the ultrasound images at the National Taiwan University Hospital or the functional MRI images at the Veterans General Hospital-Taipei.

**Keywords:** Fourier transform, fractals, Gabor analysis, wavelets, multiresolution analysis, principal component analysis, independent component analysis, sliced inverse regression, classification and regression trees, large volume data, statistical tests and decisions.

三、結果與討論

本三年期計畫到目前為止已有 10 篇論文被國際期刊接受發表，其發表狀態與部分摘要如下。


8. “A Discrete Region Competition Approach

Abstract:
Ultrasound images are difficult for analysis due to their complex textures and speckle noises. Taking into account these two characters, in this paper, we present a new region-based approach for ultrasound image segmentation. The proposed approach is composed of two primary algorithms, namely, discrete region competition and weak edge enhancement. The discrete region competition features four techniques, i.e., region competition, statistics modeling, early vision modeling, and discrete concept. To prevent a region from flooding out of the desired area, weak edges located on the slowly varying slope are enhanced according to their position on the slope and the length of the slope. The discrete region competition incorporating weak edge enhancement has been verified on clinical ultrasound images and promising results have been achieved.


Abstract:
Two common deficiencies of most conventional deformable models are the need to place the initial contour very close to the desired boundary and the incapability to capture a highly winding boundary for sonographic boundary extraction. To remedy these two deficiencies, a new deformable model, namely, the cell-based dual snake model, is proposed in this paper. The basic idea is to apply the dual snake model in the cell-based deformation manner. While the dual snake model provides an effective mechanism to allow a distant initial contour, the cell-based deformation makes it possible to catch the winding characteristics of the desired boundary. The performance of the proposed cell-based dual snake model has been evaluated on the synthetic images with the simulated speckles and the clinical ultrasound images. The experimental results show that the mean distances from the derived to the desired boundary points are $0.9 \pm 0.42$ pixels and $1.29 \pm 0.39$ pixels for the synthetic and the clinical ultrasound images, respectively.


Abstract:
A nonlinear wavelet shrinkage estimator was proposed in Huang and Lu (2000). Such an estimator combined the asymptotic equivalence to the best linear unbiased prediction and the Bayesian estimation in nonparametric mixed-effects models. In this article a data-driven GCV method is proposed to select hyperparameters. The proposed GCV method has low computational cost and can be applied to one or higher dimensional data. It can be used for selecting hyperparameters for either level independent or level dependent shrinkage. It can also be used for selecting the primary resolution level and the number of vanishing moments of wavelet basis. The strong consistency of the GCV method is proved.

四、計畫成果自評

由上述的報告中，可以發現我們的研

究內容與原計畫相符，達成預期的目標。

我們將進一步將完成的技術報告投稿到學

術期刊發表，並進一步將這些技術應用到

實際的影像分析方面，提供更正確和有效

的統計分析。因此，本計畫的研究除了在

術上分析方法的突破，也同時具備應用

的價值。

五、參考文獻


自我相似性，維度簡化及
醫學影像分析上統計方式的資料發掘(3/3)

計畫類別：■個別型計畫　□整合型計畫
計畫編號：NSC 90-2118-M-009-017
執行期間：90年8月1日至91年7月31日

計畫主持人：國立交通大學統計學研究所盧鴻興副教授
共同主持人：
計畫參與人員：

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中華民國 91年 10月 30日