Industry prize winner, SSAB2000 — Image Segmentation with Constrained Snakes

This year, Ghassan Hamarneh received the annual prize for the best industry related contribution at the SSAB2000 symposium. Ghassan Hamarneh is a PhD student in the Image Analysis Group at Chalmers University of Technology. The prize of 10 000 kr was awarded for a presentation carrying the title 'Constraining Contour Deformations Using Statistical A Priori Knowledge of Shape Without Requiring Point-to-Point Correspondence'.

Throughout history humans have been working extremely hard trying to minimize the work they do. For example, inventing transportation vehicles to reduce the time and trouble of traveling, generating electricity that will run factories producing all types of goods, etc. Along these lines comes the notion of computer vision; we want machines that will do the *seeing* for us. Seeing in humans is a task that is performed not only by the eyes but by the brain, as well. So the task of the camera is similar to that of the eye, but what replaces the brain? Well at this time, nothing does, but computers are as close as we can get. The applications of machine vision are numerous and very exciting. If machines can come close to *seeing* then we move them a step ahead in helping us perform different tasks, for example, driving our cars, inspecting the output of our factories, diagnosing patients, etc.

One of the major tasks of computer vision is what is segmentation. Many methods have been developed for attacking the segmentation problem. One of the simplest methods is thresholding. Thresholding basically assumes the object of interest appears in the image as a range of colors or shades of gray (gray levels or intensities). This simple technique doesn't work when there are other objects in the image that share the same gray-levels, these interfering objects and other imaging artifacts are referred to as noise. Other methods assume the appearance of the target object to be homogenous and thus detect the object gradually by collecting more and more pieces that fit the description of the object appearance. These methods belong to the family of region-based segmentation techniques. Edge-based techniques also exist, where boundaries of the object are sought and somehow stitched together. A bit more advanced techniques first model the object boundary as a connected and smooth curve, then overlay this curve on the image where the object is hidden, and finally try to deform (change the shape of) the curve until it clings along the boundary of the target object. A method called *Snakes* is one such method that is part of a larger set of methods dubbed *Deformable Models*.

Snakes (named so, because their deformations resemble the slithering of a snake) gained large acceptance as a segmentation tool since they performed well under varying conditions. Nevertheless, in image segmentation scenarios where high levels of noise and occlusions are present, the traditional snakes lead to unacceptable results. A remedy is to present the snake with a priori information about the shape of the object to be segmented. This is done here by studying the typical variations of the object's shape from an acquired training set of images. *Point Distribution Models* (PDMs) were previously used to describe such shape variations. PDMs were proven problematic since they require point correspondence between key points (called landmarks) in the training images. So instead shapes here are represented by shape descriptors that eliminate the need for such correspondence by using a frequency domain representation. Thus the variations of the frequencies of the object boundary shape are studied instead of the landmark points themselves. Then we augment the Snake segmentation technique with a refinement step that forces only acceptable output, i.e. segmentation results that agree with the training set of images, which improves the segmentation results considerably especially in regions with high noise and occlusions. The method is demonstrated on segmenting the human left ventricle in echocardiography (see Fig. 1 and Fig. 2).

Ghassan Hamarneh
Chalmers University of Technology

Gästforskare i Zürich

Anders Kaestner, 1999 års industriprisvinnare, har tillfälligt lämnat Halmstad för att forska vid ETH i Zürich.

Jag arbetar för tillfället som gästforskare på avdelningen för träfysik, på institutionen för trä och skogsvetenskap, Eidgenössische Technische