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Fast Approximate Energy Minimization

In this paper, authors introduces reader with one of the most useful tasks in computer vision where a lot of times pixels need to be assigned a label based on certain criterias such as disparity, etc so that we can draw valid boundaries between object in an image. One of the constraints in doing that is labels vary smoothly all over while still be able to preserve the sharp discontinuities like object boundaries in an image. Author address this area by stating how these tasks in have been mapped to energy minimization tasks where up till now conventional methods such as simulated annealing have been applied to reduce the energy but on the other hand global minimizations of these energy functions under given constraints is NP-hard.

The author introduces the concept of graph cuts to reduce the computational complexity with the help of two fast approximation algorithms namely expansion and swap moves that simultaneously change labels at a time where the expansion algorithms finds a labelling under a global minimum and the swap move handles general energy functions. This is in contrast to the conventional methods of simulated annealing that not only face combinatorial explosion but also update label of one pixel at a time and are bound to get stuck at local minima if not assisted with discretization. In another paper assigning costs to labels and penalizing the solution based on number of labels present in an energy in the expansion step optimizes the label costs as well. So by bifurcating the labelling task, authors are able to preserve more with less and able to show significant reduction in computation from exponential to polynomial time in fields ranging from homography detection, image and motion segmentation.