From LBP on Graphs to Slopes in Images

Walter G. Kropatsch ⓘ

Pattern Recognition and Image Processing Group, TU Wien, Austria
`krw@prip.tuwien.ac.at`

Abstract. Local Binary Patterns (LBP) are efficient texture descriptors by a binary code comparing the differences of grey values between a center pixel and its neighbors. This works well if the number of neighbors is constant (i.e. 4 or 8) like in digital images.

We introduce an equivalent code on graphs that allows the vertices to have different degrees. LBPs determine critical points (minima, maxima, saddles) without explicit differentiation even on plane graphs and the known drawbacks of differentiation in the presence of noise. Maximal monotonic profiles (1D curve) connect a local minimum with a local maximum while the 1D LBP between two successive extrema is always the same. A bounded range of values causes a long profile to have lower (average) inclination corresponding to a low contrast in images.

We propose to build a graph pyramid by successively contracting edges with lowest contrast and preserving critical points as much as possible. In contrast to most previous pyramid constructions these selections preserve not only the grey value range and the critical points but more importantly the high frequencies corresponding to the remaining high contrasts. Images can be reconstructed from a high pyramid level by simple inheritance from parents to childs. It is surprising how difficult it is to visually see the difference between the original image and a reconstruction using only a small percentage of colors/grey values.

We further explore the scientific question of what characterizes the neighborhoods of the critical points at a high pyramid level. We define slopes as regions of the image domain where every pair of points can be connected by a monotonic path. Such a slope can contain a single local maximum and a single local minimum but no saddle point strictly inside its domain. Saddles appear exclusively along the boundaries of slopes. The diversity of slope regions allows to partition images beyond internal and external contrast.

Several further interesting properties of slopes will be addressed during the talk.