Trainable COSFIRE filters for pattern recognition in medical imaging

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A trainable filter is a filter that is configured by the automatic analysis of a pattern specified by a user. Subsequently, such a filter can detect similar patterns. This approach is illustrated by the design of filters that can detect bifurcations in retinal fundus images. The user presents a vascular bifurcation as a local pattern of interest. The automatic analysis system applies a bank of Gabor filters to this pattern and identifies which of them respond most strongly and in which positions. The response of the composite trainable filter is then computed as a combination (e.g. a geometric mean) of the responses of the selected Gabor filters, shifted by certain off-set vectors determined in the analysis phase. We call this method Combination of Shifted Filter Responses (COSFIRE). An advantage of this approach is its ease of use, as it requires no programming effort the parameters of a filter are derived automatically from a single training pattern. This approach is further illustrated by the segmentation of blood vessels and the localization and segmentation of the optic nerve head in retinal fundus images.