Resolving local ambiguity using semantics of shape

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We demonstrate a new semantic method for automatic analysis of wide-area, high-resolution overhead imagery to tip and cue human intelligence analysts to human activity. In the open demonstration, we find and trace cars and rooftops. Our methodology, extended to analysis of voxels, may be applicable to understanding morphology and to automatic tracing of neurons in large-scale, serial-section TEM datasets.

We defined an algorithm and software implementation that efficiently finds all combinations of image blobs that satisfy given shape semantics, where image blobs are formed as a general-purpose, first step that "oversegments" image pixels into blobs of similar pixels. We will demonstrate the remarkable power (ROC) of this combinatorial-based work flow for automatically tracing any automobiles in a scene by applying semantics that require a subset of image blobs to fill out a rectangular shape, with width and height in given intervals.

In most applications we find that the new combinatorial-based work flow produces alternative (overlapping) tracings of possible objects (e.g. cars) in a scene. To force an estimation (tracing) of a consistent collection of objects (cars), a quick-and-simple greedy algorithm is often sufficient. We will demonstrate a more powerful resolution method: we produce a weighted graph from the conflicts in all of our enumerated hypotheses, and then solve a maximal independent vertex set problem on this graph to resolve conflicting hypotheses. This graph computation is almost certain to be necessary to adequately resolve multiple, conflicting neuron topologies into a set that is most consistent with a TEM dataset.

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