**Lecture 9: Feature Matching and Fitting**

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* RANSAC

RANSAC(RANdom Sample Consensus) is learning technique to estimate parameters of a model by random sampling of observed data. The algorithm has 3 steps. At first, Sample (randomly) the number of points required to fit the model. And then solve for model parameters using samples. Finally, Score by the fraction of inliners within a preset threshold of the model. Afterward, repeat 1-3 steps until the best model is found with high confidence. The number of trials S can be expressed as log(1-p)/log(1-(1-e)^k) when the number of sampled points is k. RANSAC is robust to outliers and applicable for larger number of objective function parameters than Hough transform. But computational time grows quickly with fraction of outliers and number of parameters. And it is not good for getting multiple fits.

* Hough Transform

Hough Transform has also 3 steps. At first, create a grid of parameter values. Second, each point votes for a set of parameters, incrementing those values in grid. Finally, find maximum or local maxima in grid. Fitting multiple lines is one of the simplest examples using Hough transform. Key idea is transform (x,y) into (a,b). But y=ax+b is not able to model a vertical line. So let’s use xcosθ+ysinθ = r. One problem still happens when handling continuous parameter(r,θ). There are too many possible parameters. We use a few number of quantized (r,θ). The accumulator array contains how many times each value of (r, θ) appears in the table.

There are several practical considerations like adjusting bin size and the amount of smoothing, finding multiple lines and line segments.

Hough Transform is robust to outliers, efficient and provides multiple good fits. But is has some sensitivity to noise. There are binsize trades off between noise tolerance, precision, and speed/memory. Finally, it is not suitable for more than a few parameters.