Fast Rigid Motion Segmentation via Incrementally-Complex Local Models
Supplementary Material

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Line fitting algorithm

Due to space restrictions, the line fitting algorithm could not be explained in our paper. Details can be found here.

In the context of characterizing the distribution of residuals (Eq. 11 in the paper), fitting a line segment corresponds to finding the epipolar orientation $e^f = \left[cos\theta^f, sin\theta^f\right]$ of the line that minimizes a robust distance metric to the residuals. In addition, one must find the lengths ($\beta \leq 0$ and $\gamma \geq 0$) that determine the end points $p = \beta e^f$ and $q = \gamma e^f$ where the segment finds support.

To incorporate robustness to a potentially large subset of outliers, the method is similar on a Hough transform, where a radial histogram accumulates votes from the data in support to lines with a discrete set of possible orientations. The size of the histogram bins grows exponentially in the radial direction limiting leverage effects caused by trajectories with large magnitudes. The furthest histogram bin is determined by the residual with the largest magnitude.

After populating the histogram, a gap-finding mechanism (similar to the one used for the 2D case in Eq. 17 and 18) is used to clear the votes cast by residuals after a salient gap. The direction with the largest number of votes becomes the winning direction, and the end points are determined by the furthest points, at each end, that gave support to the winning line.

Figure A shows the layout of one of these histograms, an example of support data and the discovered line segment.

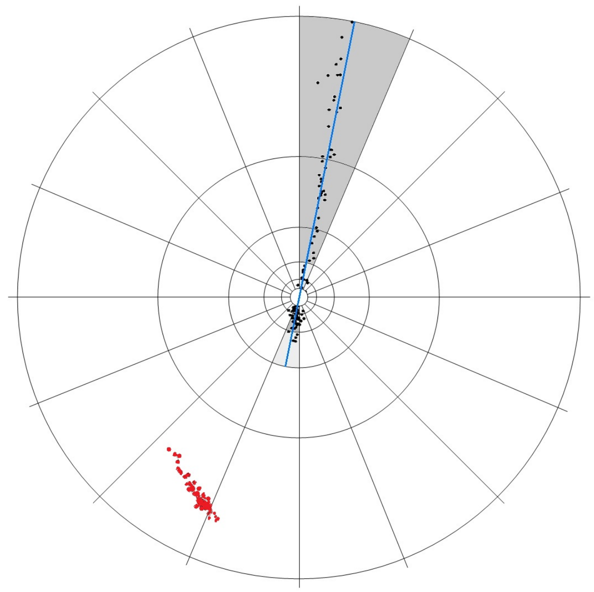

Figure A: Line fitting histogram with class-labeled residual data. Bin darkness indicates residual support. Notice how the support for the red cluster is cleared due to the presence of a gap. The blue line shows the resulting line segment.