Projection Models and Homogeneous Coordinates

RANSAC Algorithm

Refresher Course
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Topics

RANSAC – RANdom SAmple Consensus

Further Readings

RANSAC – RANdom SAmple Consensus

Problem: In calibration we have to deal with inaccuracies in observations and outliers in the data.

There are two types of outliers:

- badly localized points, and e.g. read phantom bitecode wrong :(
- wrong correspondences.

Outliers in Linear Regression

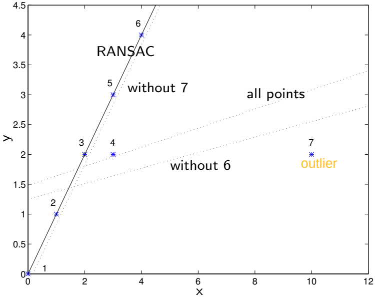

Figure 1: Example of the influence of an outlier in linear regression (least squares method)

RANSAC Algorithm

1. Draw samples uniformly and at random from the input data set.
2. Cardinality of sample set is the smallest size sufficient to estimate the model parameters. points = number of params ?
3. Compute the model parameters for each element of the sample data.
4. Evaluate the quality of the hypothetical models on the full data set.
   - Cost function for the evaluation of the quality of the model
   - Inliers: data points which agree with the model within an error tolerance
5. The hypothesis which gets the most support from the data set is taken as the best estimate.

4. all samples outside the margin get labeld as misclassified/ignored

5. model with least outliers -> best model (this is like SVR?!)

How Many Iterations? When Do We Need to Stop?

Problem: If not run often enough, we probably still have outliers.
Goal: Find a model that is determined only from inliers after N iterations.

- Model estimation requires K points.
- $p(x)$: probability that x is an inlier
- $p(y)$: prob. that at least one model that consists only of inliers is picked

Bernoulli trial: $1 - p(x)^K \rightarrow$ at least 1 out of K points is an outlier

$p(x)^k$ -> prob. for all points are inliers

After N iterations: $\left(1 - p(x)^K\right)^N \rightarrow$ prob. that all N models contain outliers

$$\Rightarrow \quad 1 - p(y) = \left(1 - p(x)^K\right)^N$$

We solve the logarithmized equation for N:

$$N = \frac{\log(1 - p(y))}{\log\left(1 - p(x)^K\right)}$$

Example

Let us consider that

- the number of model observations is 1000, and
- the number of inliers is only 100 (a worst case scenario, $p(x) = 10\%$).

Further assume:

- we have a parabolic model ($K = 3$), and
- $p(y) = 99.99999\%$.

$\Rightarrow$ N must be at least 16110.

make shure you can trust your solution

Topics

RANSAC – RANdom SAmple Consensus

Further Readings

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For the original work see:

Martin A. Fischler and Robert C. Bolles. "Random Sample Consensus: A Paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography". In: *CACM* 24.6 (June 1981), pp. 381–395. DOI: 10.1145/358669.358692