SUMMARY

In this dissertation non-parametric Bayesian methods are used in the application of robotic vision. Robots make use of depth sensors that represent their environment using point clouds. Non-parametric Bayesian methods can (1) determine how good an object is recognized, and (2) determine how many objects a particular scene contains. When there is a model available for the object to be recognized and the nature of perceptual error is known, a Bayesian method will act optimally.

In this dissertation Bayesian models are developed to represent geometric objects such as lines and line segments (consisting out of points). The *infinite line model* and the *infinite line segment model* use a non-parametric Bayesian model, to be precise, a Dirichlet process, to represent the number of objects. The line or the line segment is represented by a probability distribution. The lines can be represented by conjugate distributions and then Gibbs sampling can be used. The line segments are not represened by conjugate distributions and therefore a split-merge sampler is used.

A split-merge sampler fits line segments by assigning points to a hypothetical line segment. Then it proposes splits of a single line segment or merges of two line segments. A new sampler, the *triadic split-merge sampler*, introduces steps that involve three line segments. In this dissertation, the new sampler is compared to a conventional split-merge sampler. The triadic sampler can be applied to other problems as well, i.e., not only problems in robotic perception.

The models for objects can also be learned. In the disseration this is done for more complex objects, such as cubes, built up out of hundreds of points. An auto-encoder then learns to generate a representative object given the data. The auto-encoder uses a newly defined reconstruction distance, called the *partitioning earth mover's distance*. The object that is learned by the auto-encoder is used in a triadic sampler to (1) identify the point cloud objects and to (2) establish multiple occurances of those objects in the point cloud.