LOCAL FRAME JUNCTION TREES IN SLAM AND SURFACE INFERENCE

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Abstract

Graphical Models (GM) play an essential role in Bayesian inference. They are a highly abstract representation of our knowledge of the inference model. Variables are represented as nodes, the dependency between variables is indicated by a link (edge) between the two corresponding nodes. In a complete graph, every variable is coupled with every other one. The sequential inference on large scale complete graphs is difficult and time consuming. On the other hand, the sequential inference of a large number of independent parameters is efficiently solved by using a parallel version of fast low dimensional KF or particle filter. Many realistic inference problems lie in between those two extreme cases. The technique of junction trees (JT) allows for an efficient inference method by separating the dense cluster structures (cliques) in the graph [1]. However, the construction of a junction tree in not unique and finding a JT that has the best computational structure is a NP hard problem.

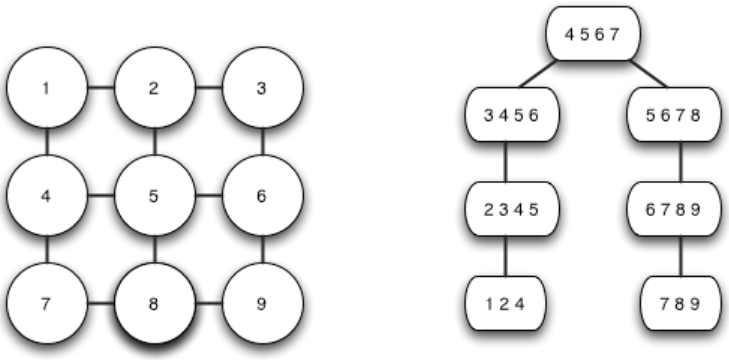

Fig. 1 A Bayesian Grid graph (left), versus its Junction Tree representation (right) with clique nodes (without separator nodes)

The sequential construction and maintenance of JTs for large scale problems can be very time consuming. In the context of surface reconstruction and the simultaneous localization and mapping (SLAM) problem we discuss how the choice of local coordinate frames can effectively be used to limit the amount of message passing on a JT. Further, since the underlying inference problem has spatial dimensions, we comment on how sequential multi-grid multi-scale inference methods can be tied into the inference scheme in order to prevent a costly "over-fitting" of observed data.

References:

[1] M. Paskin, "The Junction Tree Algorithm", http://www.stanford.edu/~paskin/gm-short-course/lec3.pdf

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