GMMCP Tracker: Globally Optimal Generalized Maximum Multi Clique Problem for Multiple Object Tracking

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Abstract

Tracking is a fundamental problem in computer vision and for decades researchers have tried to solve this problem. Looking back at recent attempts at designing new trackers, despite great performance reported on specific scenarios, still many challenges remain unsolved including occlusion, abrupt motion, appearance changes. This leaves the room open for new trackers which can better deal with tracking challenges in various scenarios. Trackers can be designed to track a single object or multiple objects in a video. Data association is the backbone to many multiple object tracking (MOT) methods. Most data association methods have considered a simplified version of the problem and focused on approximate inference methods which can be solved efficiently. On the other side, those algorithms which incorporate more accurate formulation of tracking scenario in real world suffer from greedy optimizations and local minima. In this paper authors formulate data association as a Generalized Maximum Multi Clique problem (GMMCP). GMMCP is NP-Hard. But smaller instances of the graph can be solved efficiently since problem is formulated using Binary Integer Programming and graph size can be reduced by the introduction of aggregated dummy nodes (ADN). There are numerous advantages of the proposed approach. First, it mimics the real world tracking scenario precisely by incorporating all temporal pairwise relationship in a batch of frames, i.e the graph is k-partite complete. Second, the proposed graph theoretic problem uses Binary-integer Program without simplifying the original problem. Third, it allows including high-order relationship between targets in our cost function. Fourth, it can robustly handle short/long-term occlusion. And, finally it lends itself to real-time implementation on a desktop computer.