Practical Implementation Issues of Out-Of-Sequence Measurements

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Abstract—**Out-Of-Sequence Measurements (OOSM) occur in multi-sensor systems in which there is latency between the reports of the sensors. Using these OOSM without damaging the overall tracking performance is critical to the performance of the overall tracking system. In particular, one would like to maintain the best track at any given time (i.e., process non-latent measurements) while providing an inexpensive method for updating the track state whenever the latent measurements appear.**

The OOSM problem can be dealt with in a number of different ways with varying tradeoffs. The OOSM can be discarded which will typically have a negative impact on track accuracy. The non-OOSM measurements can be buffered until the OOSM measurements arrive, which, assuming the time of arrival of the OOSM were known, would not produce at any given time the best answer with the data received up to that point, but would have the best answer as of some point in the past. The non-latent measurements can be processed whenever they coming in, and then reprocessed with the OOSM after OOSM arrival. This would produce the optimal result at any given time, but may be computationally impractical. Finally, there are approximation algorithms that use the OOSM to produce a non-optimal solution at the latest time, with hopefully lower computational complexity.

Approximation algorithms for updating both single filter, [1], [2], and Interacting Multi-Model (IMM), [3] have been suggested. All these algorithms make assumptions about the implementation that are not obvious. Among these assumptions, is the state of the system going into the update, which typically do not hold in a system with significant latencies, and assumptions about the system after the update which are unclear. Other issues, including gating, computational complexity, and missed detections have not been adequately addressed previously.

We have implemented these algorithms in two of our production trackers and will present practical issues with their implementations. We will discuss interpretation of the algorithms, gating, computational complexity and results from the implementation. We will also present a new approximation algorithm whose motivation is the gating problem.

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