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Guest Editorial: Foreword to the Special Issue on Multiple-Hypothesis Tracking

Welcome to the December 2019 issue of the *Journal of Advances in Information Fusion* (JAIF) published by the International Society for Information Fusion. *Multitarget tracking* (MTT) is an important technical challenge that has featured prominently in these pages since the inception of JAIF in 2006. Of course, the field has a much longer history. Ignoring the earlier foundational mathematical developments, we can perhaps identify the start of the field with the seminal advances to recursive estimation theory due to Kalman [1] and early work on the data association problem due to Sittler [2].

In a paper at the 1978 IEEE Conference on Decision and Control, Donald Reid presented a contribution on *multiple-hypothesis tracking* (MHT) [3]. The subsequent journal article that appeared the following year, in the December 1979 issue of the IEEE Transactions on Automatic Control, gave visibility to the approach and has been cited widely [4]. MHT is well established as the leading operational methodology for MTT and is at the core of many successful, fielded surveillance systems.

Forty years on, C.-Y. Chong and S. Coraluppi held a special session titled *Forty Years of MHT* at the 2018 International Conference on Information Fusion

(FUSION) that received great interest and participation [5]. This success encouraged us to propose a JAIF special issue on MHT: this December 2019 issue.

So, what has happened in the field from December 1979 to December 2019? We encourage readers to examine the paper by C.-Y. Chong et al. for a panoramic view of many developments, including track-oriented MHT and distributed MHT. The paper by S. Coraluppi et al. focuses on recent graph-based extensions that lead to significant computational gains in certain multisensor settings. The paper by L. Stone focuses on the target-to-measurement association hypothesis, which is different from the measurement-to-measurement hypothesis in standard MHT, showing that this definition provides an exact Bayesian solution to the MTT problem under very general assumptions. The paper by Mori et al. explores alternative mathematical formalisms for MHT.

As with other MTT paradigms, there are limitations to what can be achieved with MHT. A particular challenge is that of merged measurements, for which connections to theoretical physics are explored in the paper by W. Koch. In recent years, a popular formulation of the MTT problem in the research community has emerged via the *random finite set* (RFS) machinery. The paper by Y. Xia et al. explores multiscan processing in the RFS framework, thus offering an alternative approach to multiple-hypothesis reasoning.

We hope that the readers of this issue will find the contributions to be valuable to review some of the key advances in MTT over the past 40 years, to clarify the theoretical basis for MHT, and to identify new results and directions for promising research.

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