

Analytic Combinatorics for Multi-Object Tracking and Higher Level Fusion

Intended Audience.

The intended audience is any engineer, Ph.D. student, and interested person working in multi-object tracking and data fusion. The development should be of special interest to individuals working in what is often called random finite sets (or finite point processes), and those working on large problems requiring principled approximations. Open discussion of problems and specific interests are welcome.

Description.

This tutorial is designed to facilitate understanding of the classical theory of Analytic Combinatorics (AC) and how to apply it to problems in multi-object tracking and higher level data fusion. AC is an economical technique for encoding combinatorial problems—without information loss—into the derivatives of a generating function (GF). Exact Bayesian filters derived from the GF avoid the heavy accounting burden required by traditional enumeration methods. Although AC is an established mathematical field, it is not widely known in either the academic engineering community or the practicing data fusion/tracking community. This tutorial lays the groundwork for understanding the methods of AC, starting with the GF for the classical Bayes-Markov filter. From this cornerstone, we derive many established filters (e.g., PDA, JPDA, JIPDA, PHD, CPHD, MultiBernoulli, MHT) with simplicity, economy, and insight. We also show how to use the saddle point method (method of stationary phase) to find low complexity approximations of probability distributions and summary statistics.

Prerequisites

First course in probability or signal processing.

Presenter(s)

Roy Streit and Murat Efe

Biographies

Roy Streit Senior Scientist, Metron, Reston, Virginia, and Professor (Adjunct) of Electrical and Computer Engineering, University of Massachusetts–Dartmouth. IEEE Fellow. IEEE AESS Board of Governors, 2016-18. President, ISIF, 2012. Research interests include multi-target tracking, multi-sensor data fusion, medical imaging, signal processing, pharmacovigilance, and business analytics. Author, *Poisson Point Processes*, Springer, 2010 (Chinese translation, Science Press, 2013). Co-author, *Bayesian Multiple Target Tracking*, 2nd Edition, Artech, 2014. Seven US patents.

泊松点过程：成像、跟踪和感知, (美) Roy L. Streit 著

Murat Efe Associate Professor and Head of the Electrical and Electronics Engineering Department at Ankara University. Numerous papers in refereed journals, conferences, and seminars on target tracking/data fusion. Local coordinator of the NATO Lecture Series on Multisensor Fusion in 2012. Technical consultant to a number of defense companies on tracking and fusion related projects. On the advisory board of the Electrical, Electronics and Informatics Research Group of the Scientific and Technological Research Council of Turkey. Board of Directors of ISIF for the term 2014-2016 and again for the term 2017-2019.