Two-stage Tracker for Improved Association with Bearing-only Measurements

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Multiple-target tracking is complicated by the need to correctly associate new detections with multiple source tracks. Association is more difficult with bearing-only measurements, as crossing events are more frequent than they would be, for example, in bearing and range space. An alternative to basing association decisions on a single observation epoch is multiple hypothesis tracking (MHT), which holds in memory multiple hypotheses about detection-to-track association for several observation epochs [1,2]. MHT has the difficulty that the number of hypotheses grows exponentially with time, making it computationally unfeasible for extended crossing or fading events. In this work we propose a tracking architecture composed of two tracking stages, each with single-epoch association logic, cascaded in series with a delay between. The second stage is able to utilize bearing-rate, in addition to bearing, to aid its association decisions. With a modest increase in computational cost, this architecture shows two types of improvements on passive-sonar data: (1) modest improvement in association during crossing events, (2) consistent improvement in linking traces that have been segmented with different track identifications, due to intervals with fading or low SNR. When the tracker is viewed as an aid to a human operator, both improvements are significant in terms of reducing operator workload needed to correct track association.

[1] D. B. Reid, “An algorithm for tracking multiple targets,” IEEE Trans. Automatic Control, vol. AC-24, pp. 843-854, Dec. 1979.

[2] D. W. Pace, M. W. Owen, H. Cox, “Multiple-hypothesis multiple model line tracking," Proceedings of SPIE, vol. 4048, Signal and Data Processing of Small Targets, pp. 168-179, 2000.

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