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This report examines performance limits (Cramér-Rao bounds) on tracking a maneuvering target using bearing measurements from a single sensor on a maneuvering platform. An approximation to the Cramér-Rao bound for estimating the location, velocity, and acceleration of a constant acceleration target with a prior distribution of the target's velocity and acceleration is derived for the case where the target and the sensor are coplanar. The bound is computed for members of a two-parameter family of sensor trajectories, and optimal sensor trajectories within this two-parameter family are identified from contour plots of the bound vs the two parameters. The optimal trajectory in most cases is a weave around the line of sight to the target, with a period which is proportional to the observation time allotted for the measurement. The bound on performance is not in general very sensitive to either the sensor's or the target's motion, or to mismatch between the two, except that the period of the sensor's weave pattern influences both the time at which good estimates become available and the variance of the estimates after a given time interval. The bounds indicate that passive ranging techniques should achieve rms range accuracies on the order of 10 to 20 percent, after 40 s of maneuvering, when the target bearing is measured with a 0.3° standard deviation bearing at a 1-s update rate. Range rate accuracies are expected to be relatively poor. Simulations of an iterative least squares maximum a posteriori probability (MAP) estimator showed that the estimator performs at the level given by the bound and that it generates consistent estimates of the track accuracies. The estimator proved to be sensitive to target maneuvers that were not modeled within the estimation algorithm.					
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