1 Some applications of EM algorithm for localization

- EM algorithm [9]
- Localization using Time Advance (TA) in a GSM mobile network: TA is a quantized version of the distance between the Base Station (BS) and the Mobile Station (MS). The quantization step is about 500m. This measurement is subjected to a background noise, an unknown offset and the presence of outliers. We will see how EM algorithm can be used in this context. Results will be presented with true data.
- Angle of Arrivals (AOA) estimation: in wireless communications, mobiles emit signals that arrive at a base station via multiple paths. Estimating each paths AOA is necessary for several applications, such as mobile localization. The maximum likelihood (ML) method is known to have excellent statistical performance and is robust against coherent signals and small sample numbers. However, the high computational cost associated with ML method makes it less attractive in practice. To improve the computational efficiency of the ML approach, numerical methods such as the expectation and maximization (EM) algorithm were suggested. To improve convergence rates of EM, an sequentially updating algorithm, called SAGE for Space-Alternating Generalized EM, has been proposed in the literature [10]. We will present a recursive form. Simulations will be also presented in the context of AOA estimation.

2 Some applications of filtering for tracking

- Statistical inference on HMM (Hidden Markov Model) [4],
- Bearing Only Tracking (BOT): in BOT, the tracking of a mobile target is obtained via AOA estimation on an observation platform. It can be shown that, if the target is in a linear uniform motion w.r.t. the platform, then the range (radial distance) can not be observable. It is why the polar representation is usually preferred to cartesian representation: indeed in this case the non-observable component is not coupled with the observable components [1]. Because the non linearity of the observation w.r.t. the location of the target, Kalman Filter (KF) can not be used. EKF and particles filtering will be presented in the context of multipaths and eventual loss of the direct path. Simulations will be also presented.
- Bearing tracking on road network: we consider a road network modelled as a graph with nodes (crossing roads) and arcs. We assume that this map is perfectly known by the tracker. Particles filtering will be presented in the context of multipaths and eventual loss of the direct path. Simulations will be also presented.

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