association method presented here does not have such assumptions and will handle the possible multi-modal and/or non-Gaussian target densities in a reasonable way. See the example in Figure 4 where the particle mixtures of two targets are shown. The mean of the particle mixtures are indicated by a plus-symbol and a circle-symbol, respectively. Now assume that two detections, which are denoted by stars, have been received. The association methods proposed here will associate the lower right detection with target 1 (if the measurement noise is reasonably small, and the $P_{FA}$ is low). This is despite the fact that the mean of target 2 is very close to that detection. A Gaussian density assumption would in fact switch the association decisions yielding an unreasonable matching.

![Figure 4](image_url)  
**Fig. 4** Fictive example to illustrate the proposed association method. Particle mixtures of two targets are shown. The means of the particle mixtures are indicated by a plus-symbol and a circle-symbol, respectively. Two detections are illustrated by stars. A Gaussian density assumption would result in the switched version of the association decisions given by the particle based approach presented in this work.

### 4 Road Constrained Pedestrian Tracking with MMPF

In this section the on-road and off-road motion models and the observation model are described in more detail compared to the introduction in Section 2.1. After the specific models are presented, the multi-model particle filter algorithm is described and some implementation issues will also be considered.