# Geometrically Constrained Object Tracking in Non-Overlapping Calibrated Cameras within a Bayesian Framework

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## Declaration

I declare that this is my own work, and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning, and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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## Abstract

When establishing correspondence between objects across non-overlapping cameras, the existing methods combine separate likelihoods of appearance and kinematic features in a Bayesian framework, constructing a joint likelihood to compute the probability of re-detection. So far, no method has assumed dependence between appearance and kinematic features. In this work we introduce a novel methodology to condition the location of an object on its appearance and time, without assuming independence between appearance and kinematic features, in contrast to existing work. We characterize the linear movement of objects in the unobserved region with an additive Gaussian noise model. Assuming that the cameras are affine, we transform the noise model onto the image plane of subsequent cameras. This noise model acts as a prior to improving re-detection. We have tested our hypothesis with toy car experiments and real-world camera setups. The prior constrains the search space in a subsequent camera, greatly improving the computational efficiency. Our method also has the potential to distinguish between similar-type objects, and recover correct labels when they move across cameras.



***Index terms***— Multi-camera tracking, non-overlapping cameras, priors for object re-detection, affine transformation of noise model.



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# List of Abbreviations

| Abbreviation | Description |
|---|---|
| CCD | Charge coupled device |
| CCTV | Closed circuit television camera |
| EM | Expectation maximization |
| FOV | Field of view |
| HOG | Histogram of oriented gradients |
| 3DHOG | 3D-Histogram of oriented gradients |
| FPS | Frames per second |
| N-cut | Normalized cut |
| PDF | Probability density function |
| ROI | Region of interest |
| SURF | Speeded up robust features |

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