

# Statistical inference in computer vision

**Kobus Barnard**  
**Univ. of Arizona**

In this talk I will introduce computer vision as an inference problem. In particular, knowing what is in the world and where it is, simply by looking, implies inferring semantic information from visual data. However, this is inherently an ill-posed problem. For a given image there are many combinations of objects, backgrounds, lighting conditions, and imaging systems that could explain it. Being able to effectively resolve such ambiguities requires using prior knowledge about the world.

This suggests thinking about the problem as Bayesian inference. The forward model (likelihood) for how models of the world lead to images is simpler than the reverse problem of going from images to models. If we combine this forward model with a prior over models, then a model for the world is available from the posterior distribution. However, while this paradigm is a principled and attractive way to solve a very difficult problem, a number of technical challenges remain. These include developing effective representations for the world, constructing good likelihoods from these representations, finding good priors over the models, and searching the posterior distribution for good hypothesis about the models.

I will present some ongoing work that illustrate the above. I will discuss learning representations of objects from image data, and fitting these to image data for object recognition and understanding. I will argue that a natural and direct representation of the three dimensional world and the objects within makes more sense than an image based representation because it decouples information about the world from information about the imaging system, thereby reducing the degrees of freedom. I will also discuss constructing image likelihood functions from abstract models. Finally I will discuss some of the sampling based inference methods that we use and why they have some hope of finding good solutions within a very large and variable parameter space.