Model Fitting and Classification

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1 Introduction

One of the jobs of the measure objects code in the photometric pipeline is to fit models (currently pure exponentials, pure deVaucouleurs profiles, and the PSF) to each object detected, in each band.

The resulting paramters are of course of interest in their own right, and the likelihoods of each class of model are of value in classifying the objects.

2 Triangle and Prism Diagrams

It is well known[1] that the sums of the perpendicular distances from a point to the three sides of an unit equilateral triangle sum to one. If we define the reduced likelihoods as $\hat{\mathcal{L}} \equiv \mathcal{L}/\sum \mathcal{L}_i$, then every object may be drawn as a point within an equilateral triangle, with the three corners corresponding to perfect fits to stars, exponential disks, and deVaucouleurs profiles; such a diagram is shown in the bottom right of figure 1.

We may add a further dimension to this diagram, namely the largest Likelihood of any model's fit; I have chosen to plot this with $\mathcal{L} = 1$ at the bottom, and $\mathcal{L} = 0$ at the top. Various views of such a diagram are given in 1. An point near a vertex at the bottom is well fit by that model, and no others; a point near a vertex at the top is badly fit by all models, but it much more like that vertex's model than any other; a point lying between the 'deV' and 'exp' edges is a galaxy, but we cannot say what sort (if at the top of the figure it isn't well fit by any galaxy model, but all stars were

[1] It is, for example, exploited in the phase diagrams used in thermodynamics, whence I arrived at the diagrams presented here.

worse); and finally an object in the middle of the bottom triangle is well fit by both galaxy *and* stellar profiles.

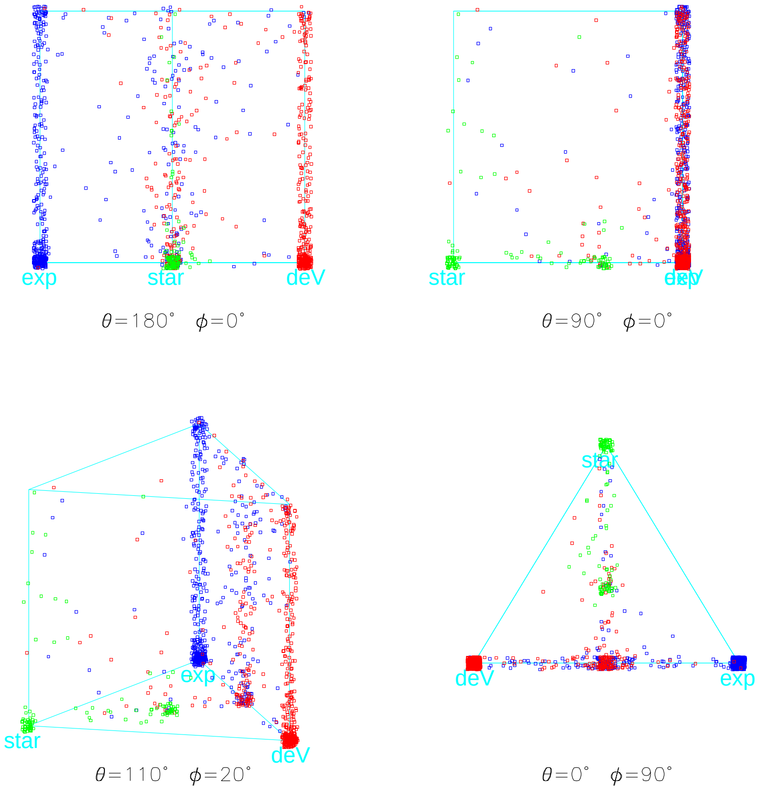

Figure 1: A classification prism seen from a number of viewpoints. Stars are shown in green, exponentials in blue, and deVaucouleurs profiles in red. The objects at the base of the prism (in the bottom left figure) are well fit, and have a maximum likelihood of 1; objects at the top have a maximum likelihood of close to 0. The points in the diagram have been slightly dithered, which causes a few of them to fall outside the prism.

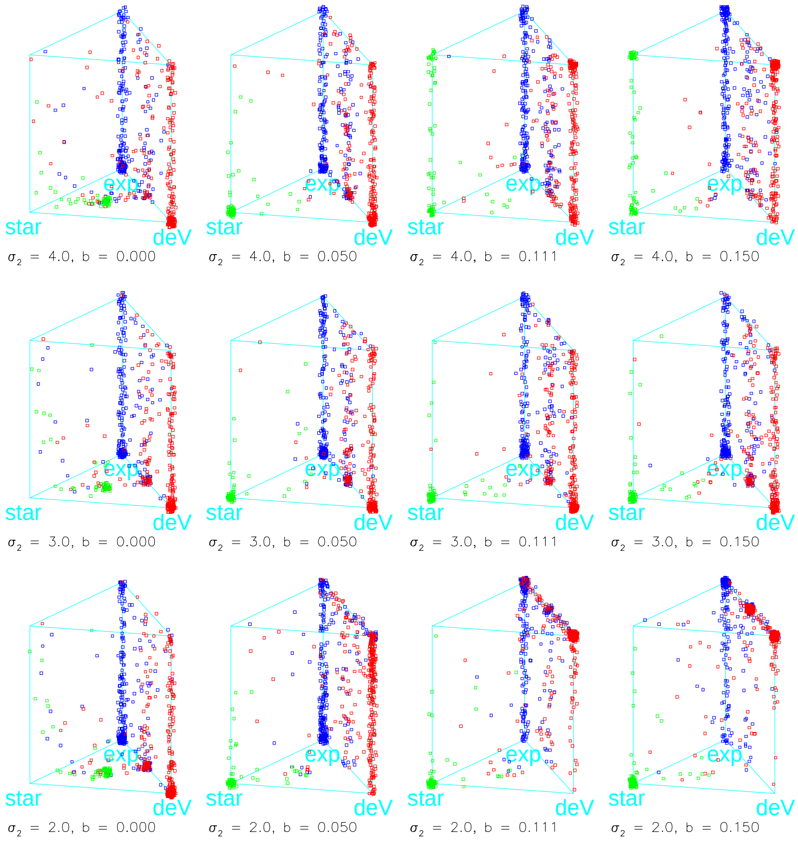

Figure 2: The classification prisms for a range of models and for different seeings. See 1 for a description of each individual prism. Each is labelled by the PSF used to create the models, which was of the form $N(\sigma_1) + bN(\sigma_2)$ where $N(s)$ is a Gaussian of standard deviation s; in all cases $\sigma_1 \equiv 1$. The cell profile tables used for this run had $\sigma_1 = \{0.75, 1.00, 1.25, 1.50, 1.75, 2.00\}$ and either $b = 0$, or $b = 1/9$, $\sigma_2 = 3\sigma_1$.