Astronomical Image Processing Lab

Presentation Script

Slide 1 - main results (SUKORNO)

welcome, will be talking you through our project

given a deep-field astronomical image

created python scripts to extract objects from image

created catalogue of objects with details including their positions + magnitudes

plotted the number of objects against their magnitude

now will go through why we did this, how we did this and what it means

Slide 2 - title (SUKORNO)

mention background image is region of sky from sloan digital sky survey, corresponding

to area where FITS image was taken

(SLIDE 1 & 2: 1 min)

Slide 3 - original FITS (SUKORNO)

here is original FITS image

taken with R-band filter; if we look at datasheet for filter, see wide range of wavelengths from yellow to near IR.

allowing to detect good, large number of objects

using the Mosaic-1 camera, which is CCD camera, on the 4 m Mayall Telescope

Kitt Peak National Observatory.

point out obvious features:

large trails:

(which we can tell are stars by their sharp diffraction streaks)

saturated CCD pixels, overflow into neighbouring pixels

deteriorated edge:

multiple images stacked to form complete image, gaps in overlap at edges

need to take these effects into account during image processing

(SLIDE 3: 1 min)

Slide 4 - what we did (DAVID)

background isolated

fitted gaussian

3sigma and 5sigma as cutoffs for what's an object

object labelling using adjacent pixel scan

interpolation of gaps

background count subtracted to get true image

re-scanned for objects, collected true count values, stored in catalogue

count -> magnitude

plot of log(N)

more detailed explanation if we have time:

* Fitted Gaussian to background portion of histogram
* Tails of Gaussian -> threshold for what’s an object
* Cropped out edge – just background, ignore
* binary check using BG threshold, create image of 1s if object and 0s if background
* -> show plot of this
* Finds groups of connected pixels, labels consecutively
* Discuss method used
* Removes any which have less than 50 pxls + relabels
* Now have isolated objects successfully
* Linearly interpolates across gaps
* Replaces filled gaps with MEDIAN (mean would weigh star bleeding too highly) value of surrounding background
* Histogram of masked, interpolated, filled background
* Now obtained true image (orig – bg)
* Histogram of true image -> distribution of brightness
* Gaussian fit to histogram
* Now we have true background, use histogram tail to isolate objects properly
* Identifies connected pixels again
* Removes small objects + relabels again
* Now isolated all images properly w/ non-background-included counts
* -> show examples of objects
* For each object, converted counts to magnitude
* -> show equations
* Plotted magnitude of objects vs apparent brightness

Slide 5 - extra what we did (DAVID)

Baye's factor to distinguish between star + galaxy

works on simulated, not real -> nevertheless, proof of concept

(SLIDE 4 & 5: 3 min)

Slide 6 - Results (DAVID)

talk through catalogue, classification of objects

logN plot, galaxy saturation at threshold; what happens if cutoff is lower?

-> more of the straight line seen, but existing plot is unaffected since we are just detecting brighter objects

-> shows deep-field distribution of galaxies

-> how could we improve?

(SLIDE 6: 3 min)

Slide 7 - Discussion (SUKORNO)

now we have our results, need to interpret what they tell us about our universe.

comparing to existing literature from images taken in same survey using same MOSAIC camera and same R-band filter, see our objects are dimmer, as they range from around 20 magnitude onwards, whereas the literature ranges from \_ to \_. this could make sense as this literature is surveying much larger area of sky with a different distribution of brighter objects.

all our detected galaxies are past the point where the linear 0.6 relationship holds, which agrees with other literature as dimmer objects above approx. 20 are also non-linear

a different example, still in R band but a compilation of multiple different telescope sources

further shows a breakdown in linearity at high magnitudes. this is because of the cutoff threshold for the dimmest objects. if we were to take in dimmer objects using a lower threshold, would see a larger portion of the relationship being linear.

here's what data could mean:

galaxy evolution

the relation expected for a homogeneous galaxy distribution in a ``Euclidean'' universe, magnitude range 16<r\*<21, agree very well and follow the prediction of the no-evolution model

actually, universe is non-euclidian, and galaxies have wide range of luminosities.

since we know universe is expanding, number count is function of redshift. and different cosmological models have different values for the degree of redshift, parameterised by q0 deceleration.

on next slide, taken with different filters and cameras entirely, can see no-evolution model underpredicts faint galaxy count, whereas recent models such as lambda CDM hypothesise merging of galaxies as they evolve, so higher number count for older, fainter galaxies before they've merged together.

although this may be valid interpretation of our data, here's why we may be wrong:

our objects are dimmer bc incorrect background correction - one way to test is use different cutoff thresholds for objects, see how much the gradient of our plot is affected when we include more or less dimmer objects.

however, would expect higher-order breakdown and rest of graph to be unaffected

also, inaccurate object identification, perhaps more rigorous method than adjacent pixel method; perhaps need to combine function fitting for more robust approach to get more accurate pixel counts, therefore magnitude values.

(SLIDE 7: 2 min)

Slide 8 - Thank you for listening