## 1. Introduction

The Third Reference Catalog of Bright Galaxies (RC3) [4] contains a complete listing of 23,022 galaxies with $D_25$ apparent major isophotal diameter greater than 1 arcminute and with a total B-band magnitude of 15.5 or greater . There has been existing literature on this subject using data from the Sloan Digital Sky Survey(SDSS). Hogg and Blanton made g,r,i colored images by using data from the SDSS DR6.[1] The EFIGI catalog [1],dedicated to studying morphology of galaxies , provides a subset of 4458 RC3 galaxies with FITS and color images using SDSS DR4 and dicarding artifacted or missing data by visual inspection. We perform the mosaicing procedures using an automated positional update algorithm on the most recent SDSS DR 10 imaging data. In addition, we designed a mosaicing pipeline that creates scientifically-calibrated mosaics as well as a set of updated position values, which can be easily suited for existing surveys such as 2MASS, DSS, or new imaging data release from Dark Energy Survey and Large Synoptic Survey Telescope for larger sky coverage and multi-band (?) mosaics.

## 2. Automation Program

### *2.1. Positional Inaccuracy in RC3 Catalog*

The principle motivation behind the automation algorithm is to resolve the problem of centering the galaxy and finding RC3 galaxy in an image.

### *2.2. Algorithm*

The rc3 class creates an rc3 object containing its "basic info" [2] for each galaxy in the RC3 catalog. The practical purpose of the class (other than the use of OOP that actually makes sense) is to keep tract of the number of iterations in the recursive step using the instance variable num_iterations.

Some parts of the program needs to be adjusted for survey-specific , but the core concept (and bulk of the code) should stay the same.

### *2.3. Parameters of Interest*

We have decided to record the The Catalogue of Principal Galaxies (PGC) number to idenitfy the RC3 galaxy of interest for cases of source confusion, since every RC3 galaxy has a unique PGC number.

[1] http://cosmo.nyu.edu/hogg/rc3/

[2] ra,dec,radius, pgc

### *2.4. Technical Details*

The program was written in Python 2.7.6 to survey-independent and interacts It uses IPAC's Montage [2] using the AstroPy Montage wrapper[3]. The final g,r,i image is created using Astromatic STIFF [3] . Our choice of program reflects best feature from both program : STIFF provides the flexibility of changing many variables for the final g,r,i; Montage creates scientifically-calibrated images by retaining astrometric accuracy during image reprojection. The use of two different program in the mosaicing step is due to Montage's ability to create scientifically-calibrated mosaic FITS, but STIFF provided more flexible parameters for combining all bands into color images, so we get the best of both worlds. The STIFF setting needs to be adjusted for each survey depending on specs on the telescope's CCD dependent parameters such as imaging bands. (?) The source extraction is done using SExtractor. If the mosaicing field is chosen correctly, then SExtractor's skylevel estimation is fairly accurate.

### *2.5. Getting the Data*

#### *2.5.1. Search*

Figure out how to convert positional values (ra,dec) to record-keeping parameters dependent on the survey's telescope. (tiles, frames...etc) [4] Usually this step can be done using the SQL search. Most surveys have an API that enables you to acess data using SQL querys so that the mosaicing program can interact with so that it doesn't have to click buttons or type in textboxes in the web GUI.

## 3. Algorithms

## 4. Pipeline

### *4.1. Class Hierarchy*

## 5. Result from SDSS run

There are _ RC3 galaxies within the footprint. on average the program processes 1.21 galaxies per minute

### *5.1. Known Errors*

Even though a series of exception handling and error prevention mechanisms were put in place,

- mProjectExec is the montage Mosaic procedure that creates the reprojected image from the raw FITS files. Sometimes reprojected images are not created even when Montages' debug statement clearly shows that the reprojection was successful and table and header files are corrupted. This results in an error in later mosaicing steps. We have implemented error prevention mechanism to ensure that mosaic procedures terminates correctly in such cases and wrote the problematic galaxy into failed_projection, which can be examined later.

[3] http://www.astropy.org/montage-wrapper/

[4] Since SDSS images are taken in drift-scan mode, we need the run,camcol,field values to acess each iamge frame

- Sometimes in the step "apply background model to images" takes a long time and produce huge files in coordir (̃)

*5.2. Performance*

We accelerate the process by “testing” only on the a single band fit file. For SDSS, that is the r band, best quality([5]) (longest wavelength =¿ most photons). Most of the time is spent on downloading the raw FITS files from the survey's specific server. Therefore the process would not be significantly sped up even if it is ran in parallel. This process can be dramatically sped up if the investigator has imaging data stored locally on a hardisk. We anticipate that this consist of simply write a subclass of the Server class and fill in some path-dependent details (where images are stored) to enable this feature. Computation time significantly increases The Montage mBgExec takes a long time .

## 6. Conclusion

¡Can talk about here how LSST and future telescope can mask theses so that image not saturated¿

## 7. Acknowledgements

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[1] A. Baillard, E. Bertin, V. de Lapparent, P. Fouqué, S. Arnouts, Y. Mellier, R. Pelló, J.-F. Leborgne, P. Prugniel, D. Makarov, L. Makarova, H. J. McCracken, A. Bijaoui, and L. Tasca. The EFIGI catalogue of 4458 nearby galaxies with detailed morphology. 532:A74, Aug. 2011. doi: 10.1051/0004-6361/201016423.

[2] G. B. Berriman, E. Deelman, J. C. Good, J. C. Jacob, D. S. Katz, C. Kesselman, A. C. Laity, T. A. Prince, G. Singh, and M.-H. Su. Montage: a grid-enabled engine for delivering custom science-grade mosaics on demand. In P. J. Quinn and A. Bridger, editors, *Optimizing Scientific Return for Astronomy through Information Technologies*, volume 5493 of *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, pages 221–232, Sept. 2004. doi: 10.1117/12.550551.

[3] E. Bertin. Displaying Digital Deep Sky Images. In P. Ballester, D. Egret, and N. P. F. Lorente, editors, *Astronomical Data Analysis Software and Systems XXI*, volume 461 of *Astronomical Society of the Pacific Conference Series*, page 263, Sept. 2012.

[4] G. de Vaucouleurs, A. de Vaucouleurs, H. G. Corwin, R. J. Buta, G. Paturel, and P. Fouque. Third Reference Cat. of Bright Galaxies (RC3) (de Vaucouleurs+ 1991). *VizieR Online Data Catalog*, 7155:0, Feb. 1995.

[5] R. Lupton, J. E. Gunn, Z. Ivezić, G. R. Knapp, and S. Kent. The SDSS Imaging Pipelines. In F. R. Harnden, Jr., F. A. Primini, and H. E. Payne, editors, *Astronomical Data Analysis Software and Systems X*, volume 238 of *Astronomical Society of the Pacific Conference Series*, page 269, 2001.