

Contents

1	Introduction	1
1.1	Variability Studies	2
1.2	Extrinsic Variables	3
1.2.1	Eclipsing Variables	3
1.3	Intrinsic Variables	5
1.3.1	Rotational Variables	6
1.3.2	Eruptive Variables	6
1.3.3	Pulsating Variables	7
1.4	Non–Stellar Variable Sources	10
1.4.1	Black Holes	10
1.4.2	Active Galactic Nuclei	11
1.5	Astronomy in the Time Domain Era	13
1.6	Machine Learning	15
1.6.1	Learning Type	15
1.6.2	Applications	17
1.6.3	Machine Learning in Astronomy	18
1.7	The High Cadence Transient Survey (HiTS)	18
1.7.1	This Work	19
1.7.2	Aims	20
1.7.3	Outline	21
2	Catalogs	23
2.1	Data Reduction	23
2.2	Source Extraction	24
2.3	Astrometric Calibrations	25
2.4	Photometric Calibrations	25
2.5	Survey depth	28
2.6	Photometric tests	29
2.7	Detected Source Catalogs	31
3	Automatic Classification	35
3.1	Feature extraction	35
3.2	Labeled Set	36
3.2.1	Catalog Cross–matching	37
3.2.2	Transfer Learning & Active Learning Tests	37
3.2.3	Data Augmentation	40

3.3	Model Training and Testing	41
3.3.1	Classification Algorithm: Random Forest	41
3.3.2	Metrics for Evaluation	42
3.3.3	Model Scheme and Testing	44
3.4	Results	49
3.4.1	Classification Biases	52
3.5	Candidates Analysis	52
3.5.1	RR Lyrae	53
3.5.2	Eclipsing Binaries	54
3.5.3	Quasars	55
4	Intermediate–Mass Black Holes	61
4.1	Previous work	61
4.1.1	IMBH Searches	61
4.1.2	Time Domain AGN	64
4.1.3	Variability Selection of IMBH	64
4.2	Data Processing and Sample Selection	66
4.2.1	HiTS data	66
4.2.2	Sample Selection	66
4.2.3	Data Processing	68
4.3	Light Curve Variability Analysis	69
4.3.1	Variability Selection	71
4.4	Occupation Fraction and Number Densities	73
4.5	Morphological Classification	75
4.6	X–Ray and Radio Counterparts	76
4.7	Future Work	78
	Summary	81
	Bibliography	85
	Appendix	95
A.	HiTS Observed Fields	95
B.	Catalog Description	98
C.	Feature Description	102