

Contents

1	Introduction	1
1.1	Stellar mass function	1
1.2	Young massive clusters in the Milky Way	3
1.3	Young massive clusters in the Galactic centre region	5
1.3.1	Star formation in the Galactic centre	5
1.3.2	Young Nuclear Cluster	7
1.3.3	Arches cluster	8
1.3.4	Quintuplet cluster	9
2	Reduction of NAOS-CONICA datasets	15
2.1	NAOS-CONICA	15
2.2	Reduction pipeline	16
2.2.1	Generation of the calibration frames	17
2.2.1.1	Dark	17
2.2.1.2	Flat field	18
2.2.1.3	Sky	18
2.2.2	Basic data reduction	19
2.2.3	50 Hz noise correction	19
2.2.4	Preparative steps before the image combination	20
2.2.4.1	Ghost masks	20
2.2.4.2	Strehl ratio and FWHM measurement	21
2.2.5	Image combination	22
3	The present-day mass function in the central part of the Quintuplet cluster	25
3.1	Observational data and data reduction	25
3.1.1	Observations in 2003	26
3.1.2	Observations in 2008	26
3.2	Photometry	27
3.2.1	Source extraction	27
3.2.2	Relative photometric calibration	28
3.2.3	Absolute photometric calibration	28
3.2.4	Error estimation	29
3.3	Completeness	30
3.4	Proper motion membership	32
3.4.1	Geometric transformation	33
3.4.2	Data selection and combination	33
3.4.3	The proper motion diagram	35
3.5	Colour-magnitude diagrams	36
3.6	Mass derivation	40

3.7	Mass functions	41
3.8	Discussion	48
4	The present-day mass function in the outer parts of the Quintuplet cluster	51
4.1	Datasets and data reduction of the Quintuplet outer fields	51
4.1.1	VLT/NACO K_s -band data	51
4.1.1.1	Datasets	51
4.1.1.2	Source detection and photometric calibration	53
4.1.1.3	Estimation of photometric and astrometric errors	56
4.1.2	HST/WFC3 data	58
4.1.2.1	Datasets and data reduction	58
4.1.2.2	Source detection and photometric calibration	60
4.1.2.3	Estimation of photometric and astrometric errors	62
4.1.3	Completeness	65
4.1.3.1	Artificial star experiments and overall completeness	65
4.1.3.2	Completeness maps	68
4.1.4	Data selection	70
4.2	Proper motion membership	72
4.2.1	Proper motion measurement	72
4.2.1.1	Geometric transformation	72
4.2.1.2	Proper motion diagram	73
4.2.2	Determination of membership probabilities	76
4.2.2.1	Method	77
4.2.2.2	Application to synthetic datasets	79
4.2.2.3	Application to synthetic models of Field 2	85
4.2.3	Proper motion membership samples based on membership probabilities	92
4.2.3.1	Field 2	92
4.2.3.2	Fields 3, 4 and 5	92
4.2.3.3	Bulk motion	96
4.3	Colour-magnitude diagrams and mass assignment	97
4.3.1	Colour-magnitude diagrams of the Quintuplet outer fields	97
4.3.1.1	Comparison with Field 1	99
4.3.1.2	Colour-magnitude diagram of Field 4	101
4.3.1.3	Area selection for Field 2	103
4.3.2	Comparison with the predictions of the synthetic models of Field 2	103
4.3.3	Surface density profile	106
4.3.4	Mass assignment	107
4.4	Mass function	107
4.4.1	Present-day mass function of the Quintuplet cluster	107
4.4.2	Total mass	114
4.4.3	Discussion	117
5	Infrared excess sources in the Quintuplet cluster	123
5.1	Datasets and data reduction	125
5.1.1	VLT/NACO L' -band data	125
5.1.2	Source detection and photometric calibration	126
5.2	Colour-colour diagrams	128

5.3	Completeness	133
5.4	Excess source fraction	135
5.5	Discussion	137
5.5.1	Comparison with other young stellar populations	137
5.5.2	Alternative sources of the L' -excess	138
6	Summary and outlook	143
A	Proper motion uncertainty (appendix for Chapter 3)	149
B	Assessment of the remaining contaminants in the cluster sample (appendix for Chapter 3)	151
B.1	Estimation of n_{cont} for $m_{\text{Pad},4\text{Myr}} \geq 18.0 M_{\odot}$	151
B.2	Estimation of n_{cont} for $m_{\text{Pad},4\text{Myr}} < 18.0 M_{\odot}$	153
B.3	Influence of hidden field stars on the mass function slope	154
C	Acronyms and abbreviations	157
	Bibliography	159
	Acknowledgements	169