

Contents

1	Introduction	7
2	Importance of the map projection analysis	9
2.1	Analysis and georeference	10
2.2	Analysis and incorrectly drawn map content	11
2.3	Cataloging of maps	13
2.4	Factors affecting the detection	15
2.4.1	Spatial dimension of features	15
2.4.2	Errors and their distribution	15
2.4.3	Distribution of features	16
2.4.4	Analyzed territory	18
2.4.5	Map scale	19
2.4.6	Map projection	20
2.4.7	Amount of the analyzed features	21
2.4.8	Map sheet	21
2.4.9	Cartographic techniques	21
2.4.10	Types of features	22
2.4.11	Timing of maps	22
2.4.12	Different accuracy of elements	23
3	Concept of the detection	24
3.1	Description of the problem	24
3.2	Determined parameters of the projection	25
3.2.1	Transformed pole position $[\varphi_k, \lambda_k]$	25
3.2.2	Standard parallel φ'_1	26
3.2.3	Longitude λ'_0 of the central meridian	26
3.2.4	Arbitrary parameter of the map projection κ	26

3.3	Determined map constants	27
3.3.1	Auxiliary sphere radius R'	27
3.3.2	Shifts $\Delta X, \Delta Y$	28
3.3.3	Angle of rotation α	28
4	Detection fundamentals	29
4.1	The 7-parameter method	30
4.2	Hybrid BFGS	32
4.3	Solving non-linear least squares using QR decomposition	33
5	Experiments and results	35
5.1	Efficiency of the analysis depending on the position . . .	36
5.2	Accuracy of input features	36
5.3	Impact of the scaling on the convergence	38
5.4	Early map: Seutter's map of America	39
5.5	Modern map: Map of air routes	40
5.6	Software detectproj	41
6	Conclusion	43