CONTENTS

PREFACE	•	. v
CHAPTER 1. INTRODUCTION		. 1
Some basic concepts and terms from projective geometry .	•	. 4
Elemental figures	•	. 4
Perspective position and projectivity	•	. 5
The anharmonic ratio	•	. 7
CHAPTER 2. GEOMETRICAL DESCRIPTION OF A THREE-DIMEN	SION	
OBJECT	•.	. 11
Coordinates in a three-dimensional, orthogonal coordinate	syste	m
(Cartesian system)	•	. 11
	•	. 11
Angles	•	. 12
Areas	•	. 13
Volumes	•	. 13
Graphic description in a plane through orthographic project	ction	. 14
CILLETTER 2 THE W RAW RECTORS AND A CENTRE AT RECT	nomic	
(DEDGEDGETHIN)	ECHC)N 17
(PERSPECTIVE)	·	. 17
	•	. 1/
The primary elements of the interior orientation	•	. 19
The physical elements of the interior orientation	•	. 20
Some elementary methods for the indirect determination	n of tl	ne
primary elements of the interior orientation	•	. 22
The principal distance, 23—The principal point, 25		
The reconstruction of bundles of rays from image coordinat	tes ar	ıd
the elements of the interior orientation	•	. 27
Numerical reconstruction of bundles of rays	•	. 27
Reconstruction of bundles of rays in projectors	•	. 30
Perspective deformations of X-ray photographs	•	. 33
Deformations caused by elevation differences in the ob	oject	. 33

Deformations caused by lacking parallelism between the planes and elevation differences in the object. Straight point	
sequences	35
The deformations of straight point sequences, conceived as	
projective transformations. Rectification	37
Rectification of plane point fields (X-ray photographs)	38
Numerical rectification, 38—Graphical rectification, 41—Optical- mechanical rectification, 42—Orthophotography, 44	
CHAPTER 4. DOUBLE-IMAGE (STEREOSCOPIC) X-RAY PHOTOGRAMMETRY	45
The normal case	45
Differential formulas for the normal case	48
Radial methods	50
The general case	52
Convergent photography	52
Some specialized cases of convergent photography, 57	
Arbitrarily directed photographs	59
Complete basic formulas for the general case, 60—Differential formulas, 63—Differential formulas of y-parallaxes, 66	
Empirical relative orientation of X-ray photographs in a stereo-	
scopic projection instrument	67
The base-height ratio	68
Stereophotogrammetry by rotation of the object	70
Stereoscopic photography by rotation of the object	70
Determination of the coordinates of points in the object after one rotation ϕ_1 only, 72—Determination of the coordinates of points in the object after two symmetrical rotations, $+\phi$ and $-\phi$, 73—Rotations of the object around three axes, 74	
CHAPTER 5. SOME SPECIFIC PROPERTIES OF X-RAY PHOTOGRAPHS OF	
IMPORTANCE FOR THE GEOMETRICAL QUALITY	77
Disturbances caused by the size of the focus in relation to the size of	
object points	77
Geometrical disturbances caused by lacking flatness of the image	
surface	79
CHAPTER & STEDEOSCODIC VIEWING OF Y-DAV PHOTOGRADUS	83
Stereoscones	86
Anadynhs and vectographs	88
Rotating shutters	00 80
Introduction of the stereoscopic floating mark	89

VIII

CONTENTS	IX
Some specific conditions to be noted in connection with stereo- scopic measurements	92
CHAPTER 7 SOME PRACTICAL APPLICATIONS OF X-RAY PHOTO-	
GRAMMETRY	95
APPENDIX I. DERIVATION OF THE FUNDAMENTAL PROJECTIVE RE-	00
LATIONS OF X-RAY PHOTOGRAMMETRY	99
Coordinate transformation in space through rotation of axes	100
The perspective transformation	106
Differential formulas	108
Spatial transformation of point groups (absolute orientation) .	112
APPENDIX II. GEOMETRICAL QUALITY PROBLEMS OF X-RAY PHOTO-	
GRAMMETRY	115
Introduction to theory of errors	115
Some concepts and terms for the quality of measurements .	116
Different types of errors of basic measurements, 116—Basic quality	
Application of the principles of theory of errors to calibration	
problems in X-ray photogrammetry	123
Partial calibration of a central projection (X-ray photograph)	123
Determination of radial distortion from variations of the principal	123
distance c , 131—Estimation of the accuracy (weight) variations of	
image coordinates, 135	
The use of measured y-parallaxes for an estimation of quality in	100
X-ray photogrammetry	136
Example of a simplified coordinate transformation procedure	
including adjustment	141
APPENDIX III DIFFERENTATION	145
Functions of measured data	145
Addition and subtraction	145
Multiplication	146
	140
	14/
Some dasic dimerential formulas	148
REFERENCES	149
INDEX	151