

Contents

Preface	iii
1 Introduction	1
2 Equation of motion and its ray solution	10
2.1 Elastodynamic equations	10
2.2 Ray series solution	12
2.3 Asymptotic power series and their basic property	15
2.4 Zero-order ray solution	18
2.5 Basic asymptotic ray theory equations for the zero-order solution	20
3 Ray kinematics	22
3.1 Eikonal equation	22
3.2 Solution of the eikonal equation by the use of characteristics .	27
3.3 Ray tracing system in isotropic media	29
3.4 Rays as extremals of Fermat's functional	39
3.5 Rays as energy flux trajectories	41
3.6 Ray tracing system in anisotropic media	43
3.7 Notes on the ray tracing system in anisotropic media	45
3.8 Rays across interfaces	47
4 Two important ray-based coordinate systems	52
4.1 Ray-centered coordinates	52
4.2 Ray coordinates	58
5 Ray dynamics	60
5.1 Ray tube	60
5.2 How to calculate the ray Jacobian	63
5.3 Dynamic ray tracing	65
5.4 Caustics	71
5.5 Calculation of ray amplitudes. Transport equation	74
5.6 Solution of the transport equation. Continuation formula	80
5.7 Notes on the continuation formula	82
5.8 Radiation function and radiation pattern	86
5.9 Ray amplitudes across a structural interface	91
5.10 Point source ray amplitude in a layered structure. Ray theory Green's function	100
6 Ray synthetic seismograms	106
6.1 The basic procedure step-by-step	106
6.2 Boundary ray tracing. Two-point ray tracing	112

6.3	Useful time functions broadly used in the ray method	113
7	Ray theory validity range	117
8	Computer program ZRAYAMP	126
8.1	Brief description of the program	126
8.2	Input and output data	129
8.3	Numerical examples	138
8.4	Troubleshooting tips	146
	References	149
	Abbreviations	152
	Selected notations	153