

Contents

Preface	vii
1 Necessary conditions for well-posedness	1
1.1 Lax-Mizohata theorem	1
1.2 Ivrii-Petkov condition	3
1.3 Implications of well posedness	7
1.4 Proof of Ivrii-Petkov condition	9
2 Hyperbolic double characteristics	19
2.1 Hamilton map	19
2.2 Ivrii-Petkov-Hörmander condition	21
2.3 Hyperbolic quadratic form	24
3 Noneffectively hyperbolic characteristics	27
3.1 Elementary decomposition	27
3.2 Case $\text{Im } F_p^2 \cap \text{Ker } F_p^2 = \{0\}$	28
3.3 Case $\text{Im } F_p^2 \cap \text{Ker } F_p^2 \neq \{0\}$	34
3.4 Vector field H_S	40
3.5 Elementary decomposition revisited	43
4 Noneffectively hyperbolic Cauchy problem I	51
4.1 C^∞ well-posedness	51
4.2 Pseudodifferential operators	52
4.3 Energy estimates	53
4.4 Levi condition	56
4.5 Strict Ivrii-Petkov-Hörmander condition	61
4.6 An example	67
5 Noneffectively hyperbolic Cauchy problem II	71
5.1 C^∞ well-posedness	71
5.2 Parametrix with finite propagation speed of wave front sets	72
5.3 Preliminaries	74
5.4 Microlocal energy estimates	76
5.5 Finite propagation speed of WF	82