

Contents

| | |
|--|----------------|
| <i>Preface</i> | <i>page ix</i> |
| 1 Introduction | 1 |
| 1. Systems under Consideration | 1 |
| 2. What Is Observability? | 2 |
| 3. Summary of the Book | 2 |
| 4. The New Observability Theory Versus the Old Ones | 3 |
| 5. A Word about Prerequisites | 4 |
| 6. Comments | 5 |
| Part I. Observability and Observers | |
| 2 Observability Concepts | 9 |
| 1. Infinitesimal and Uniform Infinitesimal Observability | 9 |
| 2. The Canonical Flag of Distributions | 11 |
| 3. The Phase-Variable Representation | 12 |
| 4. Differential Observability and Strong Differential Observability | 14 |
| 5. The Trivial Foliation | 15 |
| 6. Appendix: Weak Controllability | 19 |
| 3 The Case $d_y \leq d_u$ | 20 |
| 1. Relation Between Observability and Infinitesimal Observability | 20 |
| 2. Normal Form for a Uniform Canonical Flag | 22 |
| 3. Characterization of Uniform Infinitesimal Observability | 24 |
| 4. Complements | 26 |
| 5. Proof of Theorem 3.2 | 29 |

| | | |
|---|---|-----|
| 4 | The Case $d_y > d_u$ | 36 |
| | 1. Definitions and Notations | 37 |
| | 2. Statement of Our Differential Observability Results | 40 |
| | 3. Proof of the Observability Theorems | 42 |
| | 4. Equivalence between Observability and Observability for Smooth Inputs | 51 |
| | 5. The Approximation Theorem | 57 |
| | 6. Complements | 58 |
| | 7. Appendix | 59 |
| 5 | Singular State-Output Mappings | 68 |
| | 1. Assumptions and Definitions | 68 |
| | 2. The Ascending Chain Property | 71 |
| | 3. The Key Lemma | 73 |
| | 4. The $ACP(N)$ in the Controlled Case | 78 |
| | 5. Globalization | 81 |
| | 6. The Controllable Case | 84 |
| 6 | Observers: The High-Gain Construction | 86 |
| | 1. Definition of Observer Systems and Comments | 87 |
| | 2. The High-Gain Construction | 95 |
| | 3. Appendix | 120 |
| | Part II. Dynamic Output Stabilization and Applications | 123 |
| 7 | Dynamic Output Stabilization | 125 |
| | 1. The Case of a Uniform Canonical Form | 126 |
| | 2. The General Case of a Phase-Variable Representation | 132 |
| | 3. Complements | 141 |
| 8 | Applications | 143 |
| | 1. Binary Distillation Columns | 143 |
| | 2. Polymerization Reactors | 163 |
| | <i>Appendix</i> | 179 |
| | <i>Solutions to Part I Exercises</i> | 195 |
| | <i>Bibliography</i> | 217 |
| | <i>Index of Main Notations</i> | 221 |
| | <i>Index</i> | 224 |