

Contents

<i>About the Authors</i>	ix
<i>Preface</i>	xi
1 Introduction	1
1.1 Introduction	1
2 Dynamics of a pantograph–catenary system	9
2.1 Overview	9
2.2 Geometric characteristics of a PCS	14
2.3 Dynamic interaction between pantograph and catenary	21
2.4 Simulation techniques for a PCS	25
2.5 Vibration regularity of the catenary	40
2.6 Impact of ice covering on a PCS	46
2.7 Impact of wind on a PCS	63
2.8 Case study: Investigation of PCS interaction and optimal matching at 400 km/h	69
References	76
3 Arc in a pantograph–catenary system	79
3.1 Overview	79
3.2 Physical principles of an arc	79
3.3 Gas discharge	87
3.4 Arc physics characteristics	97
3.5 Arc model	102
3.6 Influence of complex environment on an arc	131
3.7 Meridional flow control arc method	149
3.8 Conclusion	161
References	172
4 Wear of sliding electric contact in a PCS	175
4.1 Overview	175
4.2 Friction and wear	176
4.3 Sliding electric contact	192
4.4 Model for wear of sliding electric contact	205
4.5 Sliding electric contact friction and wear characteristics of a PCS	216
4.6 Influence of environmental factors on sliding electric friction and wear	241

4.7 Case study 1	260
4.8 Case study 2	267
References	272
5 Materials for sliding electric contact in a PCS	275
5.1 Pantograph contact material	275
5.2 Properties	275
5.3 Measuring and analyzing	284
5.4 Material failure theory	309
5.5 Material preparation	315
5.6 Dip metal pantograph slide	333
5.7 Boron-reinforced carbon/copper pantograph slide	336
5.8 Carbon-based pantograph slide reinforced with a skeletal structure	351
5.9 Conclusion	363
5.10 Results	369
5.11 Learning and knowledge outcomes	372
References	373
Appendix A: Effect of ice-covered catenary on dynamic interactions of pantograph-catenary system	375
Appendix B: Magneto-hydrodynamics multiphysics field-coupling modeling method for pantograph-catenary arc based on COMSOL	405
Appendix C: Prediction model of strip wear in a pantograph-catenary system	417
Appendix D: Wear prediction based on data-driven artificial intelligence algorithms	433
Appendix E: Performance study of plasma-modified carbon fiber-reinforced carbon-based skateboard materials	457