First International Conference on Railway Technology 2012 (RAILWAYS 2012)

Research, Development and Maintenance

Civil-Comp Proceedings 98

Las Palmas de Gran Canaria, Spain
18-20 April 2012

Volume 1 of 3

Editors:

J. Pombo
# Contents

**Preface**

**Dynamics of Railway Bridges**  
Special session organised by J.M. Goicolea and R.A.B. Calçada

1. The Dynamic Behaviour of Bridge Bearings for Railway Bridges under Running Vehicles  
   1

2. Construction Engineering of the Madrid-Barcelona-French Border High Speed Railway Viaduct over the River Fluvià  
   T. Polo Orodea, C. Ramos Moreno, Á.C. Aparicio Bengoechea and G. Ramos Schneider  
   20

3. Preliminary Dynamic Assessment of Railway Bridges subject to Higher Speeds  
   C. Johansson, C. Pacoste and R. Karoumi  
   30

4. The Ultimate Response of Slender Bridges subjected to Braking Forces  
   A. Tesar  
   39

5. Dynamic Analysis of the Santana do Cartaxo Viaduct: Definition of the Experimental Verification using Statistical Analysis of the Numerical Results  
   A.H. Jesus, Z. Dimitrovová and M.A.G. Silva  
   52

6. An Integral Bridge Concept in Avoiding Railway Expansion Joints  
   D. Decloedt, B. De Pauw and Ph. Van Bogaert  
   68

7. Influence of Vibration Amplitude on the Response of a Ballasted Railway Bridge  
   M. Ülker-Kaustell  
   79

8. Evolution with Time of Vertical Train Car Accelerations on Bridges and Viaducts  
   Ph. Van Bogaert  
   98

9. A Wheel-Rail Contact Model Pre-Processor for Train-Structure Dynamic Interaction Analysis  
   P. Montenegro e Almeida, R. Calçada and N. Vila Pouca  
   113

10. A Parametric Study of the Dynamic Effects of Underpasses of High-Speed Railway Lines  
    L. Hermanns, J. Vega, E. Alarcon and A. Fraile  
    130

11. Railway Bridge Dynamics under New Multiple Units on the European Network  
    C. Anicotte, P. Schmitt and I. Bucknall  
    142
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>The Influence of Slender Pier Structures of Two Railway Viaducts on the Bridge Dynamics</td>
<td>B. De Pauw and Ph. Van Bogaert</td>
</tr>
<tr>
<td>13</td>
<td>The Stability of Ballasted Tracks Supported on Vibrating Bridge Decks, Abutments and</td>
<td>M. Baeßler, J. Bronsert, P. Cuéllar and W. Rücker</td>
</tr>
<tr>
<td></td>
<td>Transition Zones</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The Influence of Combined Track-Structure Response on the Substructure of Railway Viaducts</td>
<td>J. Thielemans and B. De Pauw</td>
</tr>
<tr>
<td>15</td>
<td>Numerical Study on the Fatigue Behaviour of a Concrete Slab Track</td>
<td>R.C. Yu, E. Poveda, J.C. Lancha, E. Arredondo and G. Ruiz</td>
</tr>
<tr>
<td>16</td>
<td>Fatigue Problems of Steel Bridges</td>
<td>Sh. Urushadze, L. Frýba, M. Škaloud, M. Pirner and M. Zörnerová</td>
</tr>
<tr>
<td>17</td>
<td>Analysis of Resonant Railway Bridges Considering Soil-Structure Dynamic Interaction</td>
<td>A. Romero, J. Domínguez and P. Galvín</td>
</tr>
<tr>
<td>18</td>
<td>Design of Tall Piers for Railway Bridges using Ant Colony Optimization</td>
<td>F.J. Martínez-Martín, F. González-Vidosa and A. Hospitaler</td>
</tr>
<tr>
<td>19</td>
<td>Fibre Reinforced Polymer Railway Decking</td>
<td>L. Canning</td>
</tr>
<tr>
<td></td>
<td>Modelling and Simulation of Railroad Vehicle Systems: Enhancements and Applications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Special session organised by A.A. Shabana, H. Sugiyama, K.E. Zaazaa and J.L. Escalona</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>A Dynamic Formulation for Railroad Vehicles using Trajectory Coordinates</td>
<td>A.M. Recuero, J.L. Escalona and R. Chamorro</td>
</tr>
<tr>
<td></td>
<td>Optimization</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Novel Rail Vehicle Concepts for a High Speed Train: The Next Generation Train</td>
<td>J. Winter</td>
</tr>
<tr>
<td></td>
<td>Artifacts</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>The Influence of Bearing Flexibility on High Speed Vehicles</td>
<td>C. Casanueva, A. Alonso and J.G. Giménez</td>
</tr>
<tr>
<td>26</td>
<td>Evaluation of the Admissible Longitudinal Compressive Forces by Means of Multibody Train</td>
<td>L. Cantone, D. Negretti and V. Vullo</td>
</tr>
<tr>
<td></td>
<td>Simulations</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Analysis of Longitudinal Forces in Heavy and Long Trains</td>
<td>G.F.M. dos Santos, R.S. Barbosa and R. Joy</td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>29</td>
<td>Stochastic Railway Dynamics: Modelling and Simulation</td>
<td>W.V. Wedig</td>
</tr>
<tr>
<td>30</td>
<td>Numerical Analysis of Derailed Vehicle Motion from Wheel-Sleeper Impacts</td>
<td>H. Sunami, Y. Terumichi and M. Adachi</td>
</tr>
<tr>
<td>32</td>
<td>Wheel Profile Optimization for High Speed Railways Considering Equivalent Conicity</td>
<td>J. Santamaria, J. Herreros, E.G. Vadillo, N. Correa and O. Oyarzabal</td>
</tr>
<tr>
<td>33</td>
<td>Modal Vibration Characteristics of Flexural Vibrations in Railway Vehicle Cabodies</td>
<td>T. Tomioka, T. Takigami and K. Aida</td>
</tr>
<tr>
<td>34</td>
<td>Enhanced Vehicle-Track Modelling: Methods, Models and Results</td>
<td>I. Kaiser</td>
</tr>
<tr>
<td>35</td>
<td>A Study of Matching Relations between Equipment Suspension Parameters and Carbody Structure</td>
<td>H.C. Wu, P.B. Wu, D.L. Yu and C.L. Zhao</td>
</tr>
<tr>
<td>36</td>
<td>Railway Composite Multifunction Structures: An Innovative Numerical Methodology to Evaluate Performance and Requirements</td>
<td>P. Pantaleone</td>
</tr>
<tr>
<td>37</td>
<td>The Use of a Displacement-Dependent Rubber Bush to Prevent Bending Vibration of a Carbody</td>
<td>T. Takigami, T. Tomioka, M. Yamanokuchi, Y. Higashi and K. Suzuki</td>
</tr>
<tr>
<td>38</td>
<td>Finite Element Simulation of the Quasi-Static Homologation Procedure for Prestressed Concrete Sleepers</td>
<td>B.O. Omondi, H. Sol and S.M. Shitote</td>
</tr>
</tbody>
</table>

**Track Condition Monitoring and Maintenance**

Special session organised by C. Vale and A. Bracciali

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Ballasted Track Superstructures: Performance of Innovative Railway Sleepers</td>
<td>M. Guerrieri and D. Ticali</td>
</tr>
<tr>
<td>40</td>
<td>CALEPIN: Optimizing Track Works during the Summer</td>
<td>E. Laurans, P. Mirambeau, P. Petit and P. Pouligny</td>
</tr>
<tr>
<td>41</td>
<td>Optimization of Track Maintenance Scheduling considering the Use of Multiple Tamping Machine Types</td>
<td>L. Quiroga and E. Schnieder</td>
</tr>
<tr>
<td>42</td>
<td>The Impact of Rail Corrugation on the Degradation of Ballast</td>
<td>J.N. Varandas, R. Silva, M.A.G. Silva, N. Lopes and P. Hölscher</td>
</tr>
<tr>
<td>43</td>
<td>A Track Quality Monitoring System Designed to be Installed on Vehicles in Normal Operation</td>
<td>A.N. Barbera, R. Corradi, P. Barilaro, Z. Li and P.L. Wacrenier</td>
</tr>
</tbody>
</table>
45 The Geometrical Rail Track Degradation Process in the Portuguese Northern Line using a Stochastic Model
C. Vale and M.L. Simões

46 Anomaly Detection in Curve Streams using the Fisher Score Test: Application to Railway Switch Monitoring
E. Côme, A. Samé, P. Aknin and M. Antoni

47 A New Method to Evaluate Track Conditions over Time
N. Bosso, A. Gugliotta and N. Zampieri

48 Predictive Railway Maintenance based on Statistical Analysis of Track Geometric Parameters
R. Insa, P. Salvador and J. Inarejos

49 Monitoring of Interaction between Railway Superstructure and Bridge
O. Plasek, O. Svabensky and M. Valenta

50 Monitoring for Track Works
E. Laurans, P. Petit, J-M. Pissot and P. Pouligny

51 High-Speed Alternating Current Field Measurement Inspection of Rails
B. Blakeley and M. Lugg

52 A Mathematical Model for Railway Track Settlement
A. Chudzikiewicz, J. Drozdziel, B. Sowinski and A. Szulczyk

53 Modelling the Railway Track Infrastructure Variability for Maintenance Operations Optimization
N. Rhayma, Ph. Bressolette, P. Breul and S. Costa D’Aguiar

54 Heavy Rail Maintenance Machinery and System Innovations: The Technical, Procedural and Human Challenges Posed by Their Introduction and Piloting within the United Kingdom
B. Counter, A. Abutair, A. Franklin and D. Tann

Vehicle Stability and Curving Issues
Special session organised by K. Zboinski and S. Iwnicki

55 The Assessment of Railway Track Conicity and the Question of Limit Radius
Y. Bezin and A. Alonso

56 A Study of the Steering Ability Index for Railway Vehicles
G. Shen and H. Wang

57 Stabilization of Single Axle Truck Hunting Motion using a Gyroscopic Damper with a Gravitational Restoring Mechanism
S.P. Lin, D. Tomimatsu, K. Nishimura, H. Yabuno and Y. Suda

58 Design Principles for High Speed Vehicle Suspensions based on Hunting Stability
C.H. Huang, J. Zeng, R. Luo, Y.J. Wang and N. Wu

59 Mechanical Semi-Active Control for Radial Steering Curving of Railway Vehicles
H. Wang and G. Shen

60 Optimisation of Railway Polynomial Transition Curves: A Method and Results
K. Zboinski and P. Woznica
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>A Comparative Study of Two Different Anti-hunting Modes for High-Speed Bogies</td>
<td>M.W. Piao, S.L. Liang, W.G. Kong, Z.G. Fang and W.Z. Zhao</td>
<td>866</td>
</tr>
<tr>
<td>62</td>
<td>Research on Linear and Nonlinear Stability of Wheelsets with Primary Suspension</td>
<td>H. Dong, J. Zeng, Y. Wang, R. Luo and Z.P. Yang</td>
<td>880</td>
</tr>
<tr>
<td>63</td>
<td>Roller Rig Implementation of Active Wheelset Steering</td>
<td>J. Kalivoda and P. Bauer</td>
<td>893</td>
</tr>
<tr>
<td>64</td>
<td>Research on the Swaying Phenomenon of the High-Speed Electric Multiple Unit</td>
<td>R. Luo, J. Zeng, H.Y. Dai and W.X. Teng</td>
<td>906</td>
</tr>
<tr>
<td>65</td>
<td>Dynamic Characteristics of a New Guiding System</td>
<td>J.M.C.S. André</td>
<td>917</td>
</tr>
<tr>
<td>66</td>
<td>Eigenvalue Analysis of Railroad Vehicles Including Track Flexibility</td>
<td>J.L. Escalona, R. Chamorro and A.M. Recuero</td>
<td>931</td>
</tr>
<tr>
<td>67</td>
<td>A Simulation Study of the Track Gauge Influence on Railway Vehicle Stability in Curves</td>
<td>K. Zboinski and M. Dusza</td>
<td>951</td>
</tr>
<tr>
<td>68</td>
<td>How to Find a Compromise between Track Friendliness and the Ability to Run at High Speed</td>
<td>E. Andersson, S. Stichel, A. Orvnäs and R. Persson</td>
<td>968</td>
</tr>
<tr>
<td>69</td>
<td>Computer Aided Design for Spatial Railway Transition Curves</td>
<td>L. Lazarević, Z. Popović and L. Puzavac</td>
<td>988</td>
</tr>
</tbody>
</table>

**Modelling and Simulation Techniques in Railway Dynamics for Virtual Homologation**

Special session organised by B. Suarez and A. Facchinetti

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>Reliable Stress Predictions for the Design of High Speed Trains</td>
<td>S.S. Ding, L.F. Jin, M. Gong, A.Q. Tian and Z. Zhang</td>
<td>1018</td>
</tr>
<tr>
<td>72</td>
<td>Experience with the Testing of Railway Vehicles according to the European Standards</td>
<td>J. Čapek and Z. Malkovský</td>
<td>1026</td>
</tr>
<tr>
<td>73</td>
<td>Middle-Frequency Wheel-Rail Contact Forces of High Speed Trains and the Validation of a Model with Field Measurements</td>
<td>X.C. Jin</td>
<td>1044</td>
</tr>
<tr>
<td>74</td>
<td>Mesh Sensitivity Analysis in the Design of High Speed Trains</td>
<td>A.Q. Tian, L.F. Jin, M. Gong, S.S. Ding and Z. Zhang</td>
<td>1060</td>
</tr>
<tr>
<td>75</td>
<td>The Influence of Modelling of the Suspension Components on the Virtual Homologation of a Railway Vehicle</td>
<td>L. Mazzola, S. Alfi and S. Bruni</td>
<td>1069</td>
</tr>
<tr>
<td>76</td>
<td>A Simulation of Train Overriding and Lateral Buckling during Collision Accidents</td>
<td>J.W. Sun, L.H. Ren and W.B. Wang</td>
<td>1082</td>
</tr>
<tr>
<td>77</td>
<td>The Influence of the Inter-Vehicle Suspension on the High Speed Electric Multiple Unit</td>
<td>Y. Wang, C.H. Huang, H.J. Kang, X.W. Song and J.Y. Guo</td>
<td>1093</td>
</tr>
</tbody>
</table>
78 SiPESC Based Optimization for the Design of High Speed Trains
M. Gong, A.Q. Tian, S.S. Ding, S. Zhang and Z. Zhang

79 A Dynamic Study of a High Speed Electric Multiple Unit Based on a Flexible Car Body
P.B. Wu, Y.L. Shan, H.C. Wu and J. Zeng

80 Numerical Studies of Rivets in the Design of a High Speed Train

Non-Intrusive Inspection and Data Analysis for Predictive Maintenance
Special session organised by J. Jaiswal and Z. Li

81 Condition Monitoring of Railway Components using Optical Fibre Bragg Grating Sensors
S.J. Buggy, S.W. James, S. Staines, R. Carroll, P. Kitson, D. Farrington, L. Drewett, J. Jaiswal and R.P. Tatam

82 Reinforcement Analysis of a Railway Arch Bridge
S.G. Cao, R.L. Chen and H.L. Tan

83 Genetic Algorithms for Optimization of Railway Track Maintenance and Renewal Activities
H. Guler, C. Hosgor, Y. Yavuz, M. Kurkcuoglu and V. Isler

84 Detection of Bolt Tightness of Fish-plated Joints using Axle Box Acceleration
Z. Li, M. Oregui, R. Carroll, S. Li and J. Moraal

85 Maintenance Performance Indicators for Railway Infrastructure Management
C. Stenström, A. Parida and D. Galar

86 Ultrasonic Testing of Hollow Axles with a Conical Rotation Scanner Phased Array Probe
U. Völz, R. Boehm, T. Heckel and W. Spruch

87 Fatigue Crack Growth in Railway Steel
D.F.C. Peixoto, P.M.S.T. de Castro and L.A.A. Ferreira

88 A Method of Measurement for the Diameter of Wheel Sets using Encoders
J. Kosmol and A. Kolka

89 Virtual Maintenance Laboratory (VirMaLab): A Modelling Approach for Optimizing Maintenance Strategies
L. Bouillaut, P. Aknin, I. Ayadi and S. Bondeux

90 On a Methodical Design Approach for Train Self-Powered Hot Box Detectors
M. Koch, M. Kurch and D. Mayer

Wheel-Rail Contact Tribology
Special session organised by R. Lewis and U. Olofsson

91 A Field Test Study of Leaf Contamination on Railhead Surfaces
Y. Zhu, U. Olofsson and R. Nilsson

92 Optimization of the Planning and Control of Locomotive Wheel Machining
L.M. Vianna, L.A.S. Lopes, L.M. Vianna and G.M.C. Viglioni

93 Uniform Wheel Wear of a Two Axle Freight Vehicle with Friction Dampers
C. Casanueva, P.-A. Jönsson and S. Stichel
94 MXRAIL: A Numerical Tool for the Design and Maintenance of Rails subject to Fatigue and Fracture  
K. Dang Van

95 The Suitability of Using Accumulated Plastic Strain to Assess the Damage at the Rail-Wheel Interfaces  
I.U. Wickramasinghe, D. Hargreaves and D. De Pellegrin

96 Squat Formation on Train Rails: Origination  
M.J.M.M. Steenbergen

97 Squat Formation on Train Rails: Growth  
M.J.M.M. Steenbergen

98 Rail Wear: Understanding the Effect of Third Body Materials  
C. Hardwick, R. Lewis, D.T. Eadie and A. Rovira

99 Wheel Wear Predictions and Analyses of High-Speed Trains  
X.C. Jin, S.G. Sun and Q. Li

100 Wear Modelling in Railway Vehicles: Development and Implementation of an Innovative Model for the Prediction of the Wheel Profile Evolution due to Wear  
J. Auciello, M. Ignesti, L. Marini, E. Meli, A. Rindi and P. Toni

Models for Railway Vehicle-Infrastructure Interaction  
Special session organised by J.E. Abdalla Filho and T. Mazilu

101 Preliminary Simulation and Design of a Weight in Motion System  
A. Rindi, L. Pugi and E. Meli

102 The Effect of the R-Value on the Lifetime of Cracked Head-Hardened Steel Rails for Subways  
H.P. Rossmanith and J. Broger

103 Criteria for Ballast Flight Initiation Induced by High Speed Trains  

104 Railway Vehicle-Bridge Interaction Considering Wheel-Rail Contact, Track Irregularities and Speed Variations  
L.F.M. Beghetto and J.E. Abdalla Filho

105 Evaluating the Performance of Three Dimensional Finite Element Modelling of High-Speed Trains  

106 Development of a Vehicle Guide Device for use on a Ballasted Track  
M. Kusuda

107 The Influence of Track Stiffness on the Measurement of the Wheel Rail Contact Force  
A. Bracciali, L. Di Benedetto, F. Piccioli and M. Cavalletti

108 Dynamic Behaviour of Reinforced Concrete Floating Slabs  
R. Carracedo, J.T. Carvalho and A.R. Takeuti

Analytical and Semi-Analytical Methods for Vibration Analysis of Rail-Foundation Structures  
Special session organised by P. Koziol and Z. Dimitrovová
109 Estimation of Parameters for Soil Vibration Caused by Railway Traffic
S.N. Polukoshko, V.F. Gonca and E.V. Uspenska

110 The Influence of Subgrade Subsidence on Train Track Dynamic Interaction
E.J. O'Brien, A. Taheri and K. Gavin

111 Dynamic Effects in Bernoulli-Euler Beams subject to a Moving Load with Variable Speed
R. Bogacz and K. Frischmuth

112 The Response of a Double-Beam on a Nonlinear Foundation arising from a Moving Load
Z. Hryniewicz and P. Koziol

113 Phase Anticipating in Two Forced Self-Sustained Oscillators
T. Pyragienė

114 Moving Loads on a Visco-Elastically Supported Beam with Localized Disturbances
Z. Dimitrovová

115 Railway Traffic Effects on Structures and the Environment
J. Benčat and J. Koňar

116 An Analysis of the Dynamic Effects of Periodic Structures subject to a Moving Load
R. Bogacz, T. Krzyżyński and P. Koziol

Rail-Soil Modelling and Vibrations Attenuation for Train Transportation
Special session organised by M. Matos Neves and P. Koziol

117 Modelling of Vibrations in Tunnels using the Finite Element Method with Perfectly Matched Layers
P. Lopes, P. Alves Costa, R. Calçada and A. Silva Cardoso

118 On the Modelling of Elastomeric Isolators to Predict the Attenuation of Track Vibration
V. Fonsterè, J. Peset, C. Saborido, A. Rodríguez and J. Poblet

119 Wavelet-Based Analysis of a Multilayered Foundation subject to a Moving Load Using Generalized
Coiflets
P. Koziol and M.M. Neves

120 The Wavelet Finite Element Analysis of a Beam subject to a Moving Load
M. Musuva and C. Mares

121 Efficiency of Ballast Mats for the Reduction of Vibrations Induced by Traffic: A Parametric Study
P. Alves Costa, P. Lopes, R. Calçada and A. Silva Cardoso

122 Viscoelastic Layer under Moving Load: Vibration Response using a Coiflet Expansion and the Finite
Element Method
M.M. Neves and P. Koziol

123 A Time Domain Boundary Element-Finite Element Coupling Approach based on the Finite Element
Implicit Green’s Functions for Induced Vibrations from High-Speed Trains
A. Romero, J. Maestre, J. Domínguez and P. Galvín

124 A Comparison of Environmental Vibratory Effects of Railway Rolling Stock using a Compound
Multibody-Finite Element Model
G. Kouroussis, C. Conti and O. Verlinden
**Tramway Systems**

Special session organised by P. Fisette and H. Sugiyama

125 Technical State Monitoring Systems for Light Rail Vehicles and Tracks  
B. Firlik and A. Chudzikiewicz 1783

126 Vehicle-Turnout Interactions on Tramways with Multiple Wheel-Rail Contact  

127 MoKoBa: A Model-Configuration Kit for the MBS-Simulation of Light-Rail Vehicles  
M. Schwickert and C. Schindler 1806

128 Condition Monitoring Algorithms for Light Rail Vehicle Suspension  
B. Firlik and B. Sowiński 1820

129 Sharp Curve Negotiation Analysis of Tramcar Vehicles with Different Bogie Architectures  
R. Corradi, G. Diana and A. Facchinetti 1834

**Characterization, Performance Evaluation and Performance Specifications of the Foundation and Track-Bed Layers**

Special session organised by E. Fortunato and A. Robinet

130 The Falling Weight Deflectometer: Application to Railway Substructure Evaluation  
J. Fernandes, A. Paixão, S. Fontul and E. Fortunato 1851

131 New Design Criteria for Railway Infrastructure: Application to a Spanish High Speed Line  
I. Gallego, S. Sanchez-Cambronero, A. Rivas and E. Laguna 1862

132 A Comparative Analysis of Railway Ballast  
H. Guler and N. Mert 1879

133 The Water Effect on the Cyclic Mechanical Behaviour of a Blanket Soil Layer of an Old Railway in France  

134 Non Destructive Tests for Evaluation of Railway Platforms: Application of Ground Penetrating Radar  
S. Fontul, E. Fortunato, F. De Chiara and A. Paixão 1903

**Switches and Crossings: Testing, Modelling and Simulation**

Special session organised by E. Kassa and V. Markine

135 Technical Development of Inspection Methods for Switches and Crossings in the East Japan Railway Company  
Y. Hori 1915

136 Simulation of Train-Turnout Interaction and Validation using Field Measurements  
C. Wan, V.L. Markine and I.Y. Shevtsov 1933

137 Field Experimental Studies of Railway Switches and Crossings  
A. Cornish, E. Kassa and R. Smith 1948

138 Modelling Turnout Behaviour when Achieving a Neutral Temperature  
T. Arts, V.L. Markine and I.Y. Shevtsov 1965

139 A Multi-Point Contact Detection Algorithm Combined with Approximate Contact Stress Theories  
I. Coleman, E. Kassa and R. Smith 1986
**Trackbed Assessment and Improvement**

Special session organised by N. Thom and L. Horníček

140 Measurement of the Magnitude of the Contact Area between Under Sleeper Pads and Ballast Bed Aggregates
   L. Horníček  
2002

141 Three-Dimensional Finite Element Analysis of Sleeper Vibration with the Influence of Ballast
   H. Sakai and A. Aikawa  
2014

142 Design of a Cover Element for Slab Track Systems
   A. Andreatta, Y. Theiner, J. Feix, G. Hofstetter, M. Kowalski and S. Knittel  
2029

143 The Effect of Under-Sleeper Pads on Trackbed Deterioration Rate
   N.H. Thom and J. Roberts  
2039

**Modelling of Railway Track-Vehicle Interaction at High Frequencies**

Special session organised by L. Baeza, A. Roda and J. Santamaria

144 The Influence of Wheelflats on the Railway Track Dynamic Response in a Time-Domain Model
   R. Fesharakifard, A. Dequidt and T. Tison  
2047

145 Topographic Modelling of a Railway Track using a Global Navigation Satellite System
   N.C. Dias, N.F. Henriques, J.M.F. Calado, M.A. Calado and S.S. Mariano  
2067

146 Selected Numerical Calculations for a Reinforced Track Substructure Subject to Various Static and Dynamic Loads
   J. Kukulski  
2081

**Vibration Analysis of Train-Bridge Time-Varying Systems and their Application**

Special session organised by R.L. Chen and Q.S. Li

147 A Review of the Trends in the Development of Dynamic Algorithms for Train-Bridge Time-Varying Systems
2090

148 Mechanical Performance of Heavy Haul Railway Bridges Retrofitted using External Prestressing CFRP Tendons
   F. Xu, L.H. Xu, H. Zeng and J. Ding  
2108

149 Coupled Vibration Analysis of a Train-Rail-Bridge System Based on Multi-Body Dynamics
   Z.J. Chen, H.P. Zhu, Z.Q. Qian, J. Li and H.Y. Cao  
2122

**Aerodynamics and Crosswind**

150 Numerical Investigations on the Inter-Car-Gap Flow for a Generic High Speed Train
2139

151 The Effect of Windbreaks on Railway Overheads subject to Cross-Winds at O Eixo Viaduct
2151

152 Large Eddy Simulation of the Flow around a Simplified Train Moving through a Crosswind Flow
   S. Krajnović, P. Ringqvist and B. Basara  
2163
High-Speed Particle Image Velocimetry of the Underfloor Flow of a Generic High-Speed Train Model
M. Jönsson, C. Wagner and S. Loose

An Investigation on the Effects of Embankment Design on Railway Vehicle Aerodynamic Coefficients
F. Cheli, F. Galli, S. Giappino, P. Schito and G. Tomasini

How a Ballast Bed Smoothes the Pressure Wave Created by a Train Entering a Tunnel
J.M.C.S. André

Mode Decomposition of Flow Structures in the Wake of Two High-Speed Trains
T.W. Muld, G. Efraimsson and D.S. Henningson

Aerodynamic Shape Optimization of High-Speed Trains
S. Krajnović, E. Helgason and H.E. Hafsteinsson

Shape Optimization of Train Head Cars using Adjoint-based Computational Fluid Dynamics
D. Jakubek and C. Wagner

Static Pressure Impact on Aerodynamics of High Speed Railway Tunnels

Numerical-Experimental Analysis of Wind-Break Fences for High Speed Railway Lines
F. Cheli, F. Ripamonti, P. Schito and G. Tomasini

Wind Tunnel Experiments with a High-Speed Train Model subject to Cross Wind Conditions
J. Haff, H. Richard, U. Fey, T. Kowalski, S. Loose and C. Wagner

Large Eddy Simulation of the Flow around one Single-Stacked Container Freight Wagon
J. Östh and S. Krajnović

Experimental Study of the Compression-Wave Generation due to Train-Tunnel Entry
D. Heine and K. Ehrenfried

A Numerical Investigation of Time-Dependent Cross-Wind Effects on an Idealised Leading Rail Car
S. Schiffer and C. Wagner

Aerodynamic Optimization of the ICE 2 High-Speed Train Nose using a Genetic Algorithm and Metamodels
J. Muñoz-Paniagua, J. García, A. Crespo and S. Krajnović

Railway Strategies and Policies

The Influence of Varying Vehicle Mass and Aerodynamic Drag on Monetary Energy Savings over the Life Cycle of a High-Speed Train
J. Pagenkopf, M. Fischer, S. Ehrenberger and H. Dittus

Technology Assessment in the High-Speed Train Manufacturing Industry: Evidence from a Case Study
S. Martins Moretto, A. Pastrana Palma and A. Brandão Moniz

The Potential for Passenger Rail Transportation in the Republic of Serbia
Z. Popović, L. Lazarević and L. Puzavac
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td>Railway Certification: Reliability, Availability, Maintainability and Safety Calculations</td>
<td>J. Faria, J. Almeida, R. Cordeiro, J. Rodrigues and R. Barbosa</td>
</tr>
<tr>
<td>170</td>
<td>Economic Analysis for Rail Projects using Fuzzy Set Theory</td>
<td>D. Al Sheikh, M. El-Cheikh and J. Omran</td>
</tr>
<tr>
<td>171</td>
<td>An Analysis of Service Quality Provided to InterRailers in Italy, Greece and Croatia</td>
<td>C. Dinis Fernandes and M. Sarmento</td>
</tr>
<tr>
<td>172</td>
<td>A Simulation Tool for Train Energy Consumption and Recoverable Energy</td>
<td>J. de D. Sanz Bobi, R. Loiero and A. De Ribera Martín</td>
</tr>
<tr>
<td>173</td>
<td>Particle Emissions from Rail Vehicles: A Review</td>
<td>S. Abbasi, U. Seligren and U. Olofsson</td>
</tr>
<tr>
<td>174</td>
<td>A Permanent Magnet-Electrically Excited Motor for High-Speed Train Applications</td>
<td>M. Schier, F. Rinderknecht and H. Dittus</td>
</tr>
<tr>
<td>175</td>
<td>The Smart Grid Applied to Railway Traction Systems: A Vision for Integration</td>
<td>T.W. Palfreyman</td>
</tr>
<tr>
<td>176</td>
<td>A New Approach to the Assessment of the Unbalance Produced by Railway Networks</td>
<td>J. de D. Sanz Bobi and R. Loiero</td>
</tr>
<tr>
<td>177</td>
<td>Models of High Speed Train Emergency Braking Deceleration for the Definition of Automatic Train Protection Intervention Curves</td>
<td>M. Malvezzi, L. Pugi, S. Papini, G. Vettori, L. Conti and S. Tesi</td>
</tr>
<tr>
<td>178</td>
<td>Algorithms for Embedded Anti-Collision Devices for Rolling Stock Safety Tasks</td>
<td>A. Levchenkov, M. Gorobetz, P. Balckars and I. Alps</td>
</tr>
<tr>
<td>179</td>
<td>Operational and Technical Testing of the European Train Control System</td>
<td>L. Ebrecht, M. Meyer zu Hörste and K. Lemmer</td>
</tr>
<tr>
<td>180</td>
<td>Development of a Train Approach Alarm System with GPS-Linked Mobile Phones</td>
<td>Y. Haranou</td>
</tr>
<tr>
<td>181</td>
<td>Finding a Real Passenger Path in a Complex Transit Network Using a Smart Card Record</td>
<td>J. Min, J. Park, S. Oh and M. Sohn</td>
</tr>
</tbody>
</table>

**Energy and Environment**

<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>182</td>
<td>Suppression of Low-Frequency Lateral Vibration by Improving the Response of Pneumatic Actuators for Tilt Control</td>
<td>A. Kazato, S. Kamoshita and Y. Yamanaga</td>
</tr>
<tr>
<td>183</td>
<td>Advanced Diagnostics for a Position Control System of the Pantographs of Tilting Trains</td>
<td>D. Bolognese, D. Ferrara, G. Jacazio and M. Sorli</td>
</tr>
<tr>
<td>184</td>
<td>The Infrastructure Costs of New Tracks for Tilting Trains compared with Non-Tilting Trains</td>
<td>H.L. Rho, G.S. Kim and S.H. Han</td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>185</td>
<td>Application of Different Control Techniques to Railway Semi-Active Suspension Systems</td>
<td>B. Allotta, L. Pugi, V. Colla, F. Bartolini and F. Cangioli</td>
</tr>
<tr>
<td>187</td>
<td>PANTOBOT: A Computer Vision System for the Automatic Inspection of Locomotive Pantographs</td>
<td>M. Sacchi, L. Ascarì, S. Cagnoni, A. Piazzi and D. Spagnoletti</td>
</tr>
<tr>
<td>188</td>
<td>Optimal Control of Pantograph-Catenary Systems using MatLab</td>
<td>An. Matvejevs and Al. Matvejevs</td>
</tr>
<tr>
<td>190</td>
<td>Aeroacoustics of a High-Speed Train Double Model at High Reynolds Numbers</td>
<td>A. Lauterbach, K. Ehrenfried, S. Loose and C. Wagner</td>
</tr>
<tr>
<td>192</td>
<td>Building a High-Speed Railway Station in Girona</td>
<td>V. Pujol Baldellou, J. Tomas Acosta, C. Ramos Moreno, Á.C. Aparicio Bengoechea and G. Ramos Schneider</td>
</tr>
<tr>
<td>193</td>
<td>Contemporary Architecture: Station Design for the Diffuse Loci of Travel</td>
<td>E. Ginelli and L. Castiglioni</td>
</tr>
</tbody>
</table>

**Keyword Index**

**Author Index**