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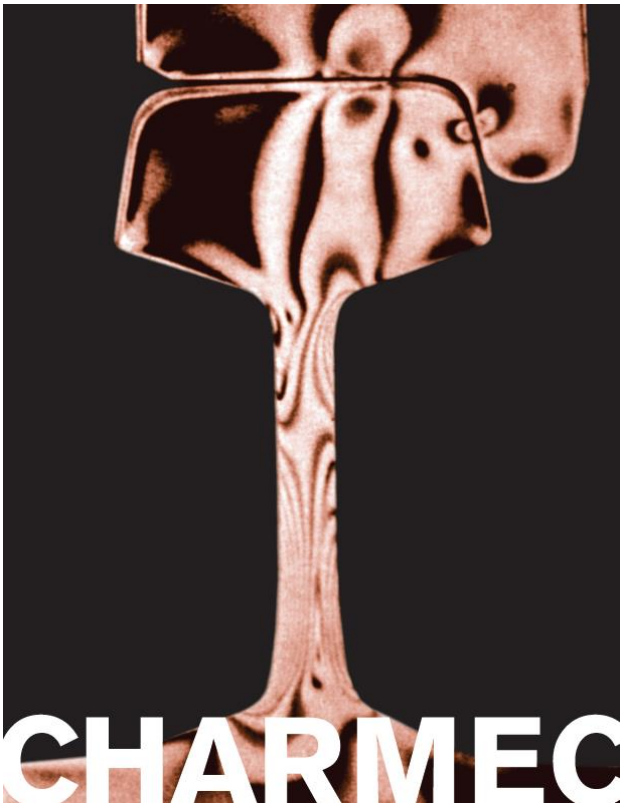

Research report 2016:01

CHARMEC Publications July 1995 – June 2015

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PREFACE

The Swedish National Competence Centre CHARMEC (CHAlmers Railway MEChanics) started at Chalmers University of Technology in July 1995. The present report lists publications from CHARMEC's research activities during the period July 1995 – June 2015, i e 20 years. In total 117 projects (including the new European projects EU15 “WRIST” and EU16 “IN2RAIL2”) have been run, out of which 24 projects were ongoing in June 2015.

The two-letter code at the project numbers relates to CHARMEC's six programme areas (see CHARMEC Triennial Reports on www.chalmers.se/charmec)

Some selected additional publications from 1988 onwards are listed on pages 118-123 under the two-letter code **SS**. The total number of listed unique publications is 960 (some of them have been listed under two or more projects).

Gothenburg in March 2016

Bengt Åkesson Roger Lundén

TS1. Calculation models of track structures

1. Tore Dahlberg: Vertical dynamic train/track interaction - verifying a theoretical model by full-scale experiments, *Proceedings 3rd Herbertov Workshop on Interaction of Railway Vehicles with the Track and Its Substructure*, Herbertov (Czech Republic) September 1994. Published in *Vehicle System Dynamics*, vol 24, supplement, 1995, pp 45-57

2. Mikael Fermér and Jens Nielsen: Vertical interaction between train and track with soft and stiff railpads - full-scale experiments and theory, *IMechE Journal of Rail and Rapid Transit*, vol 209, no F1, 1995, pp 39-47

3. Andrew Peplow, Johan Oscarsson and Tore Dahlberg: Review of research on ballast as track substructure, *Chalmers Solid Mechanics*, Research Report F189, Gothenburg 1996, 39 pp

4. Thomas Broberg, Patrik Johansson, Per Anders Jönsson, Stefan Larsson and Ulf Lång: Railway track vibrations - a benchmark test and a sleeper vibration study, Student Report, *Chalmers Solid Mechanics*, Gothenburg 1995, 46 pp

5. Ulf Mårtensson: Railway crossing vibrations, Student Report T138, *Chalmers Solid Mechanics*, Gothenburg 1996, 27 pp

6. Johan Ivarsson and Anders Johansson: Finite element model of a railway turnout, Student Report T144, *Chalmers Solid Mechanics*, Gothenburg 1996, 70 pp

7. Clas Andersson: Railway turnout vibrations, MSc Thesis 1997:1, *Chalmers Solid Mechanics*, Gothenburg 1997, 53 pp

8. Annika Igeland and Johan Oscarsson: Modelling of railway track for computer simulation of dynamic train/track interaction, *Proceedings XVth International Modal Analysis Conference (IMAC XV),* Tokyo (Japan) September 1997, pp 464-470

9. Tore Dahlberg and Clas Andersson: Vibration due to a wheelset passing a railway turnout crossing, *Proceedings WCRR´97* (*World Congress on Railway Research*), Florence (Italy) November 1997, vol E (Environment), pp 413-419

10. Johan Oscarsson, Jens Nielsen and Annika Igeland: Dynamic train/track interaction - theory and full-scale experiments, *ibidem*, vol B (Infrastructure and Track), pp 123-129

11. Johan Oscarsson and Tore Dahlberg: Dynamic train/track/ballast interaction – computer models and full-scale experiments, *Proceedings 15th IAVSD Symposium - Dynamics of Vehicles on Roads and Tracks (IAVSD 1997)*, Budapest (Hungary) August 1997, pp 73-84. Also in *Vehicle System Dynamics*, vol 29, supplement 1, 1998, pp 73-84

12. Clas Andersson and Tore Dahlberg: Wheel/rail impacts at a railway turnout crossing, *IMechE Journal of Rail and Rapid Transit*, vol 212, no F2, 1998, pp 123-134

13. Johan Oscarsson: Dynamic train/track/ballast interaction – linear and state-dependent track models, Licentiate Thesis, *Chalmers Solid Mechanics*, Gothenburg March 1999, 66 pp

14. Clas Andersson and Johan Oscarsson: Dynamic train/track interaction including state-dependent track properties and flexible vehicle components, *Proceedings 16th IAVSD Symposium - Dynamics of Vehicles on Roads and Tracks (IAVSD 1999)*, Pretoria (RSA) August-September 1999, pp 11-14. Full-length paper in *Vehicle System Dynamics*, vol 33, supplement, 2000, pp 47-58 (also listed as TS4:6)

15. Mikael Hallqvist: Track/vehicle simulation with explicit FE-code, MSc Thesis 2000:5, *Chalmers Solid Mechanics*, Gothenburg 2000, 58 pp

16. Johan Oscarsson: Dynamic train-track interaction – linear and non-linear track models with property scatter, Doctoral Dissertation, *Chalmers Solid Mechanics*, Gothenburg 2001, 130 pp (Summary and five appended papers)

17. Johan Oscarsson: Dynamic train-track interaction – variability attributable to scatter in the track properties, *Vehicle System Dynamics*, vol 37, no 1, 2002, pp 59-79

18. Johan Oscarsson: Simulation of train-track interaction with stochastic track properties, *Vehicle System Dynamics*, vol 37, no 6, 2002, pp 449-469

19. Johan Oscarsson: Dynamic train-track-ballast interaction with unevenly distributed track properties, *Vehicle System Dynamics*, vol 37, supplement, 2002, pp 385-396

20. Jens Nielsen and Johan Oscarsson: Simulation of dynamic train-track interaction with state-dependent track properties, *Journal of Sound and Vibration*, vol 275, nos 3-5, 2004, pp 515-532

TS2. Railhead corrugation formation

1. Jens Nielsen and Annika Igeland: Vertical dynamic interaction between train and track – influence of wheel and track imperfections, *Journal of Sound and Vibration*, vol 187, no 5, 1995, pp 825-839

2. Annika Igeland: Time domain solution of the dynamic interaction between railroad structures and moving loads, *Third International Congress on Industrial and Applied Mathematics (ICIAM/GAMM95)*, Hamburg (Germany) July 1995. Published in *ZAMM* (*Zeitschrift für Angewandte Mathematik und Mechanik*), vol 76, supplement 4, 1996, pp 137-140

3. Annika Igeland: Dynamic train/track interaction – parametric study and comparisons with full-scale experiments, *Engineering Foundation Conference Vehicle-Infrastructure Interaction IV*, San Diego CA (USA) June 1996, 14 pp

4. Annika Igeland and Heike Ilias: Railhead wear calculations based on high frequency wheelset/track interaction – a comparison between different models, *Proceedings 2nd MiniConference on Contact Mechanics and Wear of Rail/Wheel Systems*, Budapest (Hungary) July 1996, pp 304-314

5. Annika Igeland: Railhead corrugation growth explained by dynamic interaction between track and bogie wheelsets, *IMechE Journal of Rail and Rapid Transit*, vol 210, no F1, 1996, pp 11-20

6. Annika Igeland: Railhead wear calculations based on high frequency vehicle/track interaction, *Chalmers Solid Mechanics*, Research Report F196, Gothenburg 1996, 9 pp

7. Annika Igeland and Heike Ilias: Railhead corrugation growth predictions based on non-linear high frequency vehicle/track interaction, *Wear*, vol 213, 1997, pp 90-97 (revised article from *2nd MiniConference on Contact Mechanics and Wear of Rail/Wheel Systems*)

8. Annika Igeland: Dynamic train/track interaction – simulation of railhead corrugation growth under a moving bogie using mathematical models combined with full-scale measurements, Doctoral Dissertation, *Chalmers Solid Mechanics*, Gothenburg 1997, 84 pp (Summary and five appended papers)

TS3. Sleeper and rail pad dynamics

1. Åsa Fenander: Modal synthesis when modeling damping by use of fractional derivatives, *AIAA Journal*, vol 34, no 5, 1996, pp 1051-1058

2. Tore Dahlberg, Jan Köhler and Åsa Fenander: Ett järnvägsspårs dynamiska egenskaper - Gåsakullamätningarna 1995 (The dynamic properties of a railway track – the Goose Hill measurements 1995; in Swedish), *Seminarium Samverkan Fordon - Bana*, VTI, Linköping (Sweden) April 1996, 11 pp

3. Åsa Fenander: Fractional derivatives in damping descriptions, *Proceedings ESA International Workshop on Advanced Mathematical Methods in the Dynamics of Flexible Bodies*, Noordwijk (NL) June 1996, pp 159-166

4. Mikael Enelund, Åsa Fenander and Peter Olsson: Fractional integral formulation of constitutive equations of viscoelasticity, *AIAA Journal,* vol 35, no 8, 1997, pp 1356-1362

5. Åsa Fenander: Frequency-dependent stiffness and damping of railpads, *IMechE Journal of Rail and Rapid Transit*, vol 211, no F1, 1997, pp 51-62

6. Åsa Fenander: A fractional derivative railpad model included in a railway track model, *Journal of Sound and Vibration*, vol 212, no 5, 1998, pp 889-903

7. Åsa Fenander: Modelling stiffness and damping by use of fractional calculus with application to railpads, Doctoral Dissertation, *Chalmers Solid Mechanics*, Gothenburg 1997, 82 pp (Summary and four appended papers)

TS4. Lateral track dynamics

1. Jeanette Lavery: 2-D rail-wheel contact in train-track interaction, MSc Thesis 1999:16, *Chalmers Solid Mechanics*, Gothenburg 1999, 49 pp

2. Clas Andersson, Johan Oscarsson and Jens Nielsen: Dynamic train/track interaction including state-dependent track properties and flexible vehicle components, *Proceedings 16th IAVSD Symposium - Dynamics of Vehicles on Roads and Tracks (IAVSD 1999)*, Pretoria (RSA) August-September 1999, pp 1-14

3. Clas Andersson and Johan Oscarsson: Dynamic train/track interaction including state-dependent track properties and flexible vehicle components, *Vehicle System Dynamics*, vol 33, supplement, 1999, pp 47-58

4. Clas Andersson and Tore Dahlberg: Load impacts at a railway turnout crossing, *Proceedings 16th IAVSD Symposium - Dynamics of Vehicles on Roads and Tracks*, Pretoria August-September 1999, pp 32-34. Full length paper in *Vehicle System Dynamics*, vol 33, supplement, 2000, pp 131-142

5. Mikael Hallqvist: Track/vehicle simulation with explicit FE-code, MSc Thesis 2000:5, *Chalmers Solid Mechanics*, Gothenburg 2000, 58 pp

6. Clas Andersson and Johan Oscarsson: Dynamic train/track interaction including state-dependent track properties and flexible vehicle components, *Proceedings 16th IAVSD Symposium - Dynamics of Vehicles on Roads and Tracks (IAVSD 1999)*, Pretoria (RSA) August-September 1999, pp 11-14. Full-length paper in *Vehicle System Dynamics*, vol 33, supplement, 2000, pp 47-58 (also listed as TS1:14)

7. Clas Andersson: Modelling and simulation of general train/track interaction, Licentiate Thesis, *Chalmers Solid Mechanics*, Gothenburg 2000, 45 pp (Summary and two appended papers)

8. Clas Andersson and Thomas Abrahamsson: Simulation of interaction between a train in general motion and a track, *Vehicle System Dynamics*, vol 38, no 6, 2002, pp 433-455

9. Clas Andersson and Thomas Abrahamsson: A partitioned time integration approach for coupled systems in dynamics, *Chalmers Applied Mechanics*, Gothenburg 2002, 24 pp (contained in Clas Andersson's doctoral dissertation)

10. Clas Andersson: Vertical and lateral track dynamics – measurements, model and calibration, Research Report 2003:2, *Chalmers Applied Mechanics*, Gothenburg 2003, 38 pp

11. Clas Andersson and Anders Johansson: Prediction of rail corrugation generated by three-dimensional wheel/rail interaction, *Wear*, vol 257, nos 3-4, 2004, pp 423-434

12. Clas Andersson: Modelling and simulation of train-track interaction including wear prediction, Doctoral Dissertation, *Chalmers Applied Mechanics*, Gothenburg 2003, 163 pp (Summary and five appended papers)

TS5. Out-of-round wheels - causes and consequences

1. Anders Johansson and Jens Nielsen: Out-of-round railway wheels – a literature survey, *Chalmers Solid Mechanics*, Research Report F 210, Gothenburg 1998, 46 pp

2. Jens Nielsen and Anders Johansson: Out-of-round railway wheels – a literature survey, *IMechE Journal of Rail and Rapid Transit*, vol 214, no F2, 2000, pp 79-91

3. Anders Johansson and Jens Nielsen: Railway wheel out-of-roundness – influence on wheel-rail contact forces and track response, *Proceedings 13th International Wheelset Congress (IWC13)*, Rome (Italy) September 2001, 9 pp. This work was awarded the prize for best paper in the category “Wheel-Rail Contact”

4. Anders Johansson and Jens Nielsen: Out-of-round railway wheels – wheel-rail contact forces and track response derived from field tests and numerical simulations, *IMechE Journal of Rail and Rapid Transit*, vol 217, no F2, 2003, pp 135-146

5. Anders Johansson: Mathematical models for simulation of wheel-rail rolling contact and for prediction of wheel wear – survey of models for calculation of creep forces, spin moments and wear depths, Research Report 2003:3, *Chalmers Applied Mechanics*, Gothenburg 2003, 42 pp

6. Anders Johansson and Clas Andersson: Out-of-round railway wheels – a study of wheel polygonalization through simulation of three-dimensional wheel-rail interaction and wear, Research Report 2003:5, *Chalmers Applied Mechanics*, Gothenburg 2003, 38 pp

7. Jens Nielsen, Roger Lundén, Anders Johansson and Tore Vernersson: Train-track interaction and mechanisms of irregular wear on wheel and rail surfaces, *Vehicle System Dynamics*, vol 40, nos 1-3, 2003, pp 3-54. Also presented as an invited Keynote Lecture at *18th IAVSD Symposium, Dynamics of Vehicles on Roads and Tracks (IAVSD 2003)*, Atsugi, Kanagawa (Japan) August 2003 (also listed as SD4:2)

8. Anders Johansson and Clas Andersson: Out-of-round railway wheels – a study of formation of long periodic defects by combining analysis of wear and dynamic train-track interaction, *Proceedings 18th IAVSD Symposium, Dynamics of Vehicles on Roads and Tracks (IAVSD 2003)*, Atsugi, Kanagawa (Japan) August 2003, pp 291-293

9. Anders Johansson: Out-of-round railway wheels – literature survey, field tests and numerical simulations, Licentiate Thesis, *Chalmers Applied Mechanics*, Gothenburg 2003, 87 pp (Summary and three appended papers)

10. Anders Johansson: Out-of-round railway wheels – literature survey of wheel removal criteria and damage to track from impact loads, Research Report 2003:7, *Chalmers Applied Mechanics*, Gothenburg 2003, 28 pp

11. Anders Johansson: Out-of-round railway wheels – measurements of out-of-roundness, transverse profile and surface hardness, Research Report 2004:1, *Chalmers Applied Mechanics*, Gothenburg 2004, 40 pp

12. Anders Johansson: Out-of-round railway wheels – assessment of wheel tread irregularities in train traffic, *Proceedings 8th International Workshop on Railway Noise (IWRN8)*, Buxton, Derbyshire (UK) September 2004, vol 1, pp 297-308

13. Anders Johansson: Integrerade beräkningsmodeller för användning inom Banverksprojektet “Hjulskador” (Integrated numerical models for use within the Banverket project “Wheel Damage”; in Swedish), Research Report 2004:11, *Chalmers Applied Mechanics*, Gothenburg 2004, 19 pp

14. Anders Johansson and Clas Andersson: Out-of-round railway wheels – a study of wheel polygonalization through simulation of three-dimensional wheel-rail interaction and wear, *Vehicle System Dynamics*, vol 43, no 8, 2005, pp 539-559 (revised article from conference *IAVSD 2005)*

15. Anders Johansson and Jens Nielsen: Out-of-round railway wheels – influence of powered wheelsets with tread braking on rail corrugation growth, *Poster at 19th IAVSD Symposium, Dynamics of Vehicles on Roads and Tracks (IAVSD19)*, Milan (Italy), August– September 2005

16. Anders Johansson: Out-of-round railway wheels – assessment of wheel tread irregularities in train traffic, *Journal of Sound and Vibration*, vol 293, nos 3-5, 2006, pp 795-806 (revised article from conference *IWRN8*)

17. Anders Johansson: Out-of-round railway wheels – causes and consequences: an investigation including field tests, out-of-roundness measurements and numerical simulations, Doctoral Dissertation, *Chalmers Applied Mechanics*, Gothenburg 2005, 191 pp (Introduction, Summary and six appended papers)

18. Anders Johansson and Jens Nielsen: Rail corrugation growth – influence of powered wheelsets with wheel tread irregularities, *Wear*, vol 262, nos 11-12, 2007, pp 1296-1307 (full-length article from conference *IAVSD 2007)*

TS6. Identification of dynamic forces in trains

1. Christophe Deventer: Structural load identification with experimental evaluation, MSc Thesis 2001:8, *Chalmers Applied Mechanic*s, Gothenburg 2001, 81 pp

2. Lars Nordström and Patrik Nordberg: A critical comparison of time domain load identification methods, *Proceedings 6th International Conference on Motion and Vibration Control (MOVIC2002)*, Saitama (Japan), August 2002, vol 2, pp 1151-1156

3. Lars Nordström and Patrik Nordberg: A time delay method to solve non-collocated input estimation problems, *Mechanical Systems and Signal Processing*, vol 18, no 6, 2004, pp 1469-1483

4. Lars Nordström: Load identification using time domain methods, Licentiate Thesis, *Chalmers Applied Mechanics*, Gothenburg 2003, 57 pp (Summary and two appended papers)

5. Johanna Lilja: Identification of a finite element railway wheelset model, MSc Thesis 2003:6, *Chalmers Applied Mechanics*, Gothenburg 2003, 58 pp

6. Lars Nordström: A dynamic programming algorithm for input estimation on linear time-variant systems, *Computer Methods in Applied Mechanics and Engineering*, vol 195, no 44-47, 2006, pp 6407-6427

7. Lars Nordström: Comments on 'A dynamic programming algorithm for input estimation on linear time-variant systems', *Chalmers Applied Mechanics*, Gothenburg 2005, 5 pp

8. Lars Nordström, Håkan Johansson and Fredrik Larsson: A strategy for input estimation with sensitivity analysis, *International Journal for Numerical Methods in Engineering*, vol 69, no 11, 2007, pp 2219-2246. Also presented at *8th US National Congress on Computational Mechanics (USNCCM8)*, Austin TX (USA) July 2005

9. Lars Nordström: Input estimation in structural dynamics, Doctoral Dissertation, *Chalmers Applied Mechanics*, Gothenburg November 2005, 141 pp (Introduction, Summary and five appended papers)

TS7. Dynamics of track switches

1. Jan Henrik Sällström (editor), Tore Dahlberg, Magnus Ekh and Jens Nielsen: State-of-the-art study on railway turnouts – dynamics and damage / Förstudie om spårväxlar – dynamik och slitage (both English and Swedish version), Research Report 2002:7, *Chalmers Applied Mechanics*, Gothenburg 2002, 50 pp

2. Jan Henrik Sällström: Railway switches in Sweden – research towards enhanced reliability and maintenance, *Proceedings International Railway Conference on Switches and Crossings*, Delft (NL) March 2002, 18 pp

3. Elias Kassa: Simulation of dynamic interaction between train and turnout, Licentiate Thesis, *Chalmers Applied Mechanics*, Gothenburg 2004, 56 pp

4. Elias Kassa, Clas Andersson and Jens Nielsen: Simulation of dynamic interaction between train and railway turnout, *Vehicle System Dynamics*, vol 44, no 3, 2006, pp 247-258

5. Elias Kassa and Göran Johansson: Simulation of train-turnout interaction and plastic deformation of rail profiles, *Vehicle System Dynamics*, vol 44, supplement, 2006, pp 349–359. Also presented at *19th IAVSD Symposium*, Milan (Italy) August – September 2005

6. Martina Wiest, Elias Kassa, Werner Daves, Jens Nielsen and Heinz Ossberger: Assessment of methods for calculating contact pressure in wheel-rail/switch contact, *Proceedings 7th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2006)*, Brisbane (Australia) September 2006, vol 2, pp 501-508

7. Martina Wiest, Elias Kassa, Werner Daves, Jens Nielsen and Heinz Ossberger: Assessment of methods for calculating contact pressure in wheel/rail/switch contact, *Wear*, vol 265, nos 9-10, 2008, pp 1439-1445 (revised article from conference *CM2006*)

8. Elias Kassa and Jens Nielsen: Stochastic analysis of dynamic interaction between train and railway turnout, *Vehicle System Dynamics*, vol 46, no 5, 2008, pp 429-449

9. Elias Kassa and Jens Nielsen: Dynamic interaction between train and railway turnout – full-scale field test and validation of simulation models, *Vehicle System Dynamics*, vol 46, supplement 1, 2008, pp 521-534. Also presented at *20th IAVSD Symposium*, Berkeley CA (USA) August 2007 (also listed as EU10:4)

10. Elias Kassa and Jens Nielsen: Dynamic train-turnout interaction in an extended frequency range using a detailed model of track dynamics, *Journal of Sound and Vibration*, vol 320, nos 4-5, 2009, pp 893-914

11. Elias Kassa: Dynamic train-turnout interaction – mathematical modelling, numerical simulation and field testing, Doctoral Dissertation, *Chalmers Applied Mechanics*, Gothenburg 2007, 123 pp (Introduction, Summary and six appended papers)

TS8. Integrated track dynamics

1. Jens Nielsen, Anders Ekberg, Elena Kabo and Roger Lundén: Integrated analysis of dynamic train/track interaction and rolling contact fatigue, *Proceedings 14th International Wheelset Congress (IWC14)*, Orlando FL (USA) October 2004, 15 pp (also listed as MU9:14)

2. Jens Nielsen, Jonas Ringsberg and Luis Baeza: Influence of railway wheel flat impact on crack growth in rails, *Proceedings 8th International Heavy Haul Conference (IHHC8)*, Rio de Janeiro (Brazil) June 2005, pp 789-797

3. Jens Nielsen: Utvärdering av hjulskadedetektorer (Assessment of wheel impact load detectors; in Swedish), *Chalmers Applied Mechanics*, Gothenburg 2005, 11 pp

4. Jens Nielsen, Anders Ekberg and Roger Lundén: Influence of short-pitch wheel/rail corrugation on rolling contact fatigue of railway wheels, *IMechE Journal of Rail and Rapid Transit*, vol 219, no F3, 2005, pp 177-187 (also listed as MU9:18 and SP11:4). This paper received the *IMechE Railway Division W A Agnew / C N Goodall Award 2005*

5. Elena Kabo, Jens Nielsen and Anders Ekberg: Prediction of dynamic train-track interaction and subsequent material deterioration, *Proceedings 19th IAVSD Symposium Dynamics of Vehicles on Roads and Tracks (IAVSD19),* Milan (Italy), August– September 2005, 3 pp (also listed as MU9:19)

6. Anders Karlström, Jens Nielsen and Anders Boström: Train/track-soil numerical-analytical interaction model in the time domain, *Chalmers Applied Mechanics*, Research Report 2006:8, Gothenburg 2006 (also listed as VB8:6)

7. Jens Nielsen: High-frequency vertical wheel-rail contact forces – validation of a prediction model by field testing, *Proceedings 7th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2006)*, Brisbane (Australia) September 2006, vol 1, pp 41-48 (also listed as SP11:2)

8. Luis Baeza, Alejandro Roda and Jens Nielsen: Railway vehicle/track interaction analysis using a modal substructuring approach, *Journal of Sound and Vibration*, vol 293, nos 1-2, 2006, pp 112-124

9. Elena Kabo, Jens Nielsen and Anders Ekberg: Prediction of dynamic train/track interaction and subsequent material deterioration in the presence of insulated rail joints, *Vehicle System Dynamics*, vol 44, supplement 1, 2006, pp 718-729 (also listed as MU9:22 and SP8:3)

10. Jens Nielsen: High-frequency vertical wheel/rail contact forces – validation of a prediction model by field testing, *Wear*, vol 265, nos 9-10, 2008, pp 1465-1471 (revised article from conference *CM2006. A*lso listed as SP11:9)

11. Anders Ekberg, Elena Kabo, Jens Nielsen and Roger Lundén: Subsurface initiated rolling contact fatigue of railway wheels as generated by rail corrugation, *International Journal of Solids and Structures*, vol 44, no 24, 2007, pp 7975-7987 (also listed as MU10:9, MU22:1 and SP11:5)

12. Elias Kassa and Jens Nielsen: Stochastic analysis of dynamic interaction between train and railway turnout, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+20 pp (Summary and PowerPoint presentation)

13. Jens Nielsen: Out-of-round wheels, in *Wheel-Rail Interface Handbook* (editors Roger Lewis and Ulf Olofsson), Woodhead Publishing, Cambridge (UK) 2009, pp 245-279

14. Jens Nielsen, Oskar Lundberg and Nicolas Renard: Reduction of railway rolling noise by use of rail dampers – results from a field test in Tjörnarp, Research Report 2009:06, *Chalmers Applied Mechanics*, Gothenburg 2009, 63 pp

15. Jens Nielsen: Inverkan av ökad tåghastighet på vertikal dynamisk kontaktkraft mellan hjul och räl vid en isolerskarv – en parameterstudie (Influence of increased train speed on dynamic contact force between wheel and rail at an insulated joint – a parameter study; in Swedish), Research Report 2011:14, *Chalmers Applied Mechanics,* Gothenburg 2011, 19 pp

16. Astrid Pieringer, Wolfgang Kropp and Jens Nielsen: The influence of contact modelling on simulated wheel/rail interaction due to wheel flats, *Proceedings 9th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2012)*, Chengdu (China) August 2012, pp 406-415 (also listed as VB10:12 and VB12:1)

17. Astrid Pieringer, Wolfgang Kropp and Jens Nielsen: The influence of contact modelling on simulated wheel/rail interaction due to wheel flats, *Wear*, vol 314, nos 1-2, 2014, pp 273-281 (revised article from conference *CM2012*. Also listed as VB10:14 and VB12:6)

18. Anders Ekberg, Elena Kabo and Jens Nielsen: Allowable wheel loads, crack sizes and inspection intervals to prevent rail breaks, *Proceedings International Heavy Haul Association Conference (IHHA 2015)*, Perth (Australia) June 2015, pp 30-38 (also listed as MU22:34)

TS9. Track dynamics and sleepers

1. Jonas Zachrisson: Reliability optimization with application to sleeper design, MSc Thesis 2004:6, *Chalmers Applied Mechanics*, Gothenburg December 2004, 41 pp. This work was awarded Swedtrain's (Swedish Association of Railway Industries) Prize 2005 for Best Master's Thesis in Railway Technology

2. Johanna Lilja, Thomas Abrahamsson and Jens Nielsen: Experimental investigation of stochastic boundary conditions – planning a railway sleeper test, *Proceedings 24th International Modal Analysis Conference* (*IMAC XXIV),* St Louis MO (USA) January-February 2006, 7 pp

3. Benoît Duveiller: Statistical evaluation of structural dynamics problems with application to sleeper design, MSc Thesis 2006:47, *Chalmers Applied Mechanics*, Gothenburg 2006, 79 pp

4. Johanna Lilja: Preliminaries for probabilistic railway sleeper design, Licentiate Thesis, *Chalmers Applied Mechanics*, Gothenburg 2006, 70 pp (Summary and two appended papers)

5. Thomas Abrahamsson, Johanna Lilja and Jens Nielsen: Towards probabilistic design of railway sleepers, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+14 pp (Summary and PowerPoint presentation)

6. Johanna Lilja, Thomas Abrahamsson and Jens Nielsen: On the adequacy of metamodelling techniques in probabilistic design of railway sleepers, *Proceedings 4th ASRANet International Colloquium*, Athens (Greece) June 2008, 10 pp

7. Sadegh Rahrovani: Test data evaluation from field measurements of sleeper-ballast interface, *Chalmers Applied Mechanics*, Research Report 2010:05, Gothenburg 2010, 53 pp

TS10. Track response when using Under Sleeper Pads (USP)

1. Rikard Bolmsvik: Influence of USP on the track response – a literature survey, *Abetong Teknik AB*, Växjö (Sweden) 2005, 15 pp

2. Anders Johansson: Under Sleeper Pads – influence on dynamic train/track interaction, Research Report 2006:02, *Chalmers Applied Mechanics*, Gothenburg 2006, 35 pp

3. Anders Johansson, Jens Nielsen, Rikard Bolmsvik, Anders Karlström and Roger Lundén: Under Sleeper Pads – influence on dynamic train-track interaction, *Proceedings 7th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2006)*, Brisbane (Australia) September 2006, vol 2, pp 583-592 (also listed as VB8:7)

4. Andreas Lundqvist, Rikard Larsson and Tore Dahlberg: Influence of railway track stiffness variations on wheel/rail contact force, *Proceedings Workshop Track for High-Speed Railways*, Faculty of Engineering of the University of Porto (Portugal) October 2006, pp 67-78

5. Johan Jonsson, Philippe Schneider, Rikard Bolmsvik, Tony Johansson and Jens Nielsen: Experimental study of the influence of USP on track response using LSQ on field measurement data, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+18 pp (Summary and PowerPoint presentation)

6. Anders Johansson, Jens Nielsen, Rikard Bolmsvik, Anders Karlström and Roger Lundén: Under sleeper pads – influence on dynamic train–track interaction*, Wear*, vol 265, nos 9-10, 2008, pp 1479-1487 (revised article from conference *CM2006*. Also listed as VB8:10)

7. Philippe Schneider, Rikard Bolmsvik and Jens Nielsen: In-situ performance of a ballasted track with under sleeper pads, Research Report 2009:07, *Chalmers Applied Mechanics*, Gothenburg 2010, 22 pp

8. Philippe Schneider, Rikard Bolmsvik and Jens Nielsen: In-situ performance of a ballasted railway track with under sleeper pads, *IMechE Journal of Rail and Rapid Transit,* vol 225, no F3, 2011, pp 299-309

9. Fredrik Jansson and Jens Nielsen: Field measurements of track geometry, stiffness and vibration in a transition zone with under sleeper pads in the Malmö City Tunnel, Research Report 2012:08, *Chalmers Applied Mechanics,* Gothenburg 2012, 33 pp (and 3 appendices, 4+2+4 pp)

TS11. Rail corrugation growth on curves

1. Peter Torstensson: Rail corrugation growth on curves, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+34 pp (Summary and PowerPoint presentation)

2. Peter Torstensson and Jens Nielsen: Monitoring of rail corrugation growth due to irregular wear on a railway metro curve, *Wear*, vol 267, nos 1-4, 2009, pp 556-561. Also presented at *17th International Conference on Wear of Materials (WOM2009)* in Las Vegas NV (USA) April 2009

3. Peter Torstensson and Jens Nielsen: Simulation of dynamic train-track interaction on small radius curves subjected to rail corrugation, *Poster at 21st IAVSD Symposium Dynamics of Vehicles on Roads and Tracks (IAVSD 2009)*, Stockholm (Sweden) August 2009

4. Jim Brouzoulis, Peter Torstensson, Richard Stock and Magnus Ekh: Prediction of wear and plastic flow in rails – test rig results, model calibration and numerical prediction, *Proceedings 8th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2009)*, Florence (Italy) September 2009, vol 2, pp 701-710 (also listed as MU20:4)

5. Peter Torstensson: Rail corrugation growth on curves, Licentiate Thesis, *Chalmers Applied Mechanics*, Gothenburg 2009, 74 pp (Introduction, Summary and three appended papers)

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4. Jens Nielsen, Adam Mirza, Philipp Ruest, Anders Frid, Steven Cervello, Roger Müller and Brice Nelain: Train induced ground vibration – optimized rolling stock mitigation measures and their parameters, RIVAS Deliverable D5.4, January 2013, 81 pp

5. Roger Müller, Brice Nelain, Jens Nielsen and Estelle Bongini: Description of the vibration generation mechanism of turnouts and the development of cost effective mitigation measures, RIVAS Deliverable D3.6, January 2013, 129 pp

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7. Jens Nielsen, Eric Berggren, Thomas Lölgen, Roger Müller, Bert Stallaert and Lise Pesqueux: Overview of methods for measurement of track irregularities important for ground-borne vibration, RIVAS Deliverable D2.5, July 2013, 49 pp

8. Jens Nielsen, Adam Mirza, Philipp Ruest, Philipp Huber, Steven Cervello, Roger Müller and Brice Nelain: Guideline for the design of vehicles generating reduced ground vibration, RIVAS Deliverable D5.5, December 2013, 46 pp

9. Adam Mirza, Anders Frid and Jens Nielsen: Reduction of train induced ground vibration by vehicle design, *Proceedings 11th International Workshop on Railway Noise* (*IWRN11*), Uddevalla (Sweden) September 2013, pp 583-590

10. Roger Müller, Jens Nielsen and Brice Nelain: Ground-borne vibration mitigation measures for turnouts: state-of-the-art and field tests, *Proceedings 11th International Workshop on Railway Noise* (*IWRN11*), Uddevalla (Sweden) September 2013, pp 607- 614

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14. Jens Nielsen: RIVAS – Railway Induced Vibration Abatement Solutions, *18th Nordic Seminar on Railway Technology*, Bergen (Norway) October 2014, 1+21 pp (Summary and PowerPoint presentation)

15. Jens Nielsen, Geert Lombaert and Stijn François: A hybrid model for the prediction of ground-borne vibration due to discrete wheel/rail irregularities, *Journal of Sound and Vibration*, vol 345, 2015, pp 103-120

16. Jens Nielsen, Adam Mirza, Steven Cervello, Philipp Huber, Roger Müller, Brice Nélain and Philipp Ruest: Reducing train-induced ground-borne vibration by vehicle design and maintenance, *International Journal of Rail Transportation,* vol 3, no 1, 2015, pages 17-39

EU13. D-RAIL – Development of the Future Rail Freight System to Reduce the Occurrences and Impact of Derailment

1. Helena Almegius, Jonatan Berg, Alexander Kärkkäinen and Susanna Lindberg: Kan detektorer förebygga urspårning? (Can detectors prevent derailment?; in Swedish but with a detailed abstract in English), BSc Thesis 2012:07, *Chalmers Applied Mechanics,* Gothenburg 2012, 46 pp (and 7 appendices, 1+1+1+1+1+8+1 pp)

2. Martin Andersson: Derailment in track switches, MSc Thesis 2012:22, *Chalmers Applied Mechanics*, Gothenburg 2012, 40 pp

3. Tore Vernersson, Roger Lundén, Elena Kabo and Anders Ekberg: Wheel fracture – sensitivity to extreme loads for two generic wheel designs, *Proceedings 17th International Wheelset Congress* (*IWC17*), Kiev (Ukraine) September 2013, pp 38-47

4. Tore Vernersson, Roger Lundén and Anders Ekberg: Tread braking – fatigue life of railway wheel webs, *Proceedings Eurobrake 2014 Conference,* Lille (France) May 2014, 13 pp

Deliverables D-RAIL

11. Francesco Braghin, Anders Ekberg, Björn Pålsson, Dimitri Sala, Dirk Nicklisch, Elena Kabo, Paul Allen, Philip Schackelton, Tore Vernersson and Michael Pineau: Analysis and mitigation of derailment, assessment and commercial impact, D3.2, 2013, 283 pp + annex 18 pp
12. Anders Ekberg, Björn Pålsson, Dimitri Sala, Dirk Nicklisch, Elena Kabo, Paul Allen, Philip Schackelton, Tore Vernersson and Michael Pineau: Guidelines on derailment analysis and prevention, D3.3, 2013, 38 pp
13. Lukas Hejzlar (editor): Analysis of tests for the validation of numerical simulations, D6.1, 2014, 36 pp + 2 annexes, 1+13 pp (Chalmers responsible for section 3 Numerical analyses)
14. Wali Nawabi (editor): Existing derailment RAMS and economic studies and D-RAIL approach, D7.1, 2014, 59 pp (Chalmers responsible for sections 3.1.1 Current status regarding derailments and 3.3.1 Potential modifications to infrastructure/vehicle/ regulations/ maintenance etc to minimize derailment risks)
15. Wali Nawabi (editor): RAMS analysis and recommendation (technical focus), D7.2, 2014, 116 pp + 3 annexes 5+6+4 pp (Chalmers responsible for sections 2.3.3 Top derailment causes and 3.4 Use of monitoring systems in maintenance procedures, and parts of section 2.3.8 Considering of EU-related projects)
16. Björn Paulsson and Anders Ekberg: Scientific and technical review by acknowledged scientists and railway experts, D7.5, 2014, 11 pp (Trafikverket and Chalmers responsible for the report)
17. Björn Paulsson and Anders Ekberg: Dissemination and implementation of D-RAIL results, D8.3, 2014, 15 pp (Trafikverket and Chalmers responsible for the report)
18. François Defossez (editor): Exploitation of results from D-RAIL, D8.4, 2014, 17 pp (Chalmers responsible for parts of section 2 D-RAIL exploitable results)

EU14. Capacity4Rail

1. Jens Nielsen, Björn Pålsson and Peter Torstensson: Switch panel design based on simulation of accumulated rail damage in a railway turnout, *Proceedings 10th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2015)*, Colorado Springs CO (USA) August – September 2015, 9 pp

SP1. Lucchini Sweden AB (bilateral agreement)

1. Roger Lundén, Jürgen Schneider and Tore Vernersson: New wheelsets for 25 and 30 tonne axle loads, *6. Internationale Schienenfahrzeugtagung*, Dresden (Germany) October 2003, 6 pp (also listed as SD4:3)

2. Tore Vernersson and Roger Lundén: Temperatures at railway tread braking – a parametric study, *Proceedings 15th International Wheelset Congress (IWC15)*, Prague (Czech Republic) September 2007, 16 pp

3. Roger Lundén, Tore Vernersson and Anders Ekberg: Railway axle design – to be based on fatigue initiation or crack propagation?, *Proceedings 9th International Heavy Haul Conference (IHHA 2009),* Shanghai (China) June 2009, vol I, pp 509-517

4. Roger Lundén, Tore Vernersson and Anders Ekberg: Railway axle design – to be based on fatigue initiation or crack propagation?, *IMechE Journal of Rail and Rapid Transit*, vol 224, no F5, 2010, pp 445-453 (revised article from conference *IHHA 2009*)

SP2. Noise from Swedish railways

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SP3. Track force measurements on X2

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SP4. VAE AG GmbH (bilateral agreement)

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SP5. voestalpine Schienen GmbH (bilateral agreement)

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SP6. Development of a quiet rail

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SP7. Lateral track stability

1. Elena Kabo, Anders Ekberg and Lars Jacobsson: Railway track stability – a state-of-the-art survey, Research Report 2004:2, *Chalmers Applied Mechanics*, Gothenburg 2004, 94 pp

2. Erland Johnson: Measurement of forces and neutral temperatures in railway rails - an introductory study, Report 2004:11, Building Technology and Mechanics, *SP Swedish National Testing and Research Institute*, Borås (Sweden) 2004, 69 pp

3. Elena Kabo, Anders Ekberg and Lars Jacobsson: Spårstabilitet − en introduktion för bantekniker (Track stability − an introduction for track technicians; in Swedish), Research Report 2004:3, *Chalmers Applied Mechanics*, Gothenburg 2004, 20 pp

4. Erland Johnson: The mathematics behind a guided wave technique for rail force determination, SP Technical Note 2005:10, *SP Swedish National Testing and Research Institute,* Borås (Sweden) 2005, 24 pp

5. Erland Johnson: Vibrational methods for measuring axial rail force, SP Technical Note 2005:11, Building Technology and Mechanics, *SP Swedish National Testing and Research Institute,* Borås (Sweden) 2005*,* 47 pp

6. Lars Jacobsson: User element for ABAQUS designed to represent ballast resistance, SP Technical Note 2005:12, *SP Swedish National Testing and Research Institute,* Borås (Sweden) 2005, 12 pp

7. Lars Jacobsson: A plasticity model for ballast resistance, SP Report 2005:27, *SP Swedish National Testing and Research Institute,* Borås (Sweden) 2005, 35 pp

8. Elena Kabo: Ballastgeometrins inverkan på spårets sidomotstånd - en parameterstudie (Influence of ballast geometry on the lateral resistance of the track - a parametric study; in Swedish), Research Report 2005:09, *Chalmers Applied Mechanics*, Gothenburg 2005, 29 pp

9. Henrik Snygg: Resonansstudie av spårsystem – räl, pads, slipers och ballast (Resonance study of track systems – rail, pads, sleepers and ballast; in Swedish), SP Technical Note 2006:10, Building Technology and Mechanics, *SP Swedish National Testing and Research Institute*, Borås (Sweden) 2006, 34 pp

10. Elena Kabo: A numerical study of the lateral ballast resistance in railway tracks, *IMechE Journal of Rail and Rapid Transit*, vol 220, no F4, 2006, pp 425-433

11. Elena Kabo and Anders Ekberg: Numerisk prediktering av uppkomst av solkurvor – modellering, analys, inledande parameterstudie samt indatagenerering (Numerical prediction of the formation of sun-kinks – modelling, analysis, preliminary parametric study and input data generation; in Swedish), Research Report 2007:02, *Chalmers Applied Mechanics*, Gothenburg 2007, 16 pp

12. Anders Ekberg and Elena Kabo: PRESOL – pre-processor för solkurveanalys (PRESOL – pre-processor for sun-kink analysis; in Swedish), Research Report 2007:03, *Chalmers Applied Mechanics,* Gothenburg 2007, 11 pp

13. Erland Johnson, Gunnar Kjell, Lars Jacobsson, Robert Lillbacka, Anders Ekberg and Elena Kabo: Lateral spårstabilitet – slutrapport (Lateral track stability – final report; in Swedish), Research Report 2007:04, *Chalmers Applied Mechanics,* Gothenburg 2007, 31 pp

14. Elena Kabo and Anders Ekberg: Preventing sun-kinks, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+16 pp (Summary and PowerPoint presentation)

15. Gunnar Kjell and Erland Johnson: Measuring axial forces in rail by forced vibrations – experiences from a full-scale laboratory experiment, *IMechE Journal of Rail and Rapid Transit*, vol 223, no F3, 2009, pp 241-254

SP8. Design of insulated joints

1. Jens Nielsen: Modellering av isolerskarv i DIFF (Modelling of an insulated joint in DIFF; in Swedish), Research Report 2004:13, *Chalmers Applied Mechanics*, Gothenburg 2004, 7 pp

2. Elena Kabo: Förstudie av isolerskarvars inverkan på spårets mekaniska egenskaper − en finit element-analys (Prestudy of the influence of an insulated joint on the mechanical properties of the track – a finite element analysis; in Swedish), Research Report 2004:14, *Chalmers Applied Mechanics*, Gothenburg 2004, 12 pp

3. Elena Kabo, Jens Nielsen and Anders Ekberg: Prediction of dynamic train-track interaction and subsequent material deterioration in the presence of insulated rail joints, *Vehicle System Dynamics*, vol 44, supplement 1, 2006, pp 718-729 (also listed as TS8:9 and MU9:22)

SP9. Sleeper design for 30 tonne axle load

1. Rikard Bolmsvik and Jens Nielsen: Sleeper for 30 tonne axle load, part I – initial study, *Abetong Teknik AB*, Växjö (Sweden) 2004, 10 pp

2. Rikard Bolmsvik and Jens Nielsen: Sleeper for 30 tonne axle load, part II – extended studies, *Abetong Teknik AB*, Växjö (Sweden) 2005, 17 pp

3. Rikard Bolmsvik and Jens Nielsen: Ny sliper för 35 tons axellast (New sleeper for 35 tonne axle load; in Swedish), *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+18 pp (Summary and PowerPoint presentation)

SP10. Noise reduction measures and EU project QCITY

1. Nicolas Renard, Jens Nielsen, Henrik Malker and Henrik Samuelsson: Definition of a reference system for freight trains to compare against in quantification analyses – the Tjörnarp site for railway noise studies, Technical Report QCITY, *EU Sixth Framework Programme*, Contract no TIP4-CT-2005-516420, 19 pp and 10 appendices

2. Jens Nielsen: Banverkets FUD-projekt med fokus på rullkontaktbuller – status januari 2007 och förslag på fortsättning (Banverket's research projects on rolling noise – status January 2007 and suggestions for continued research; in Swedish), Research Report 2007:06, *Chalmers Applied Mechanics*, Gothenburg 2007, 17 pp

3. Jan Spännar: Tillståndsbedömning av räfflor och vågor med hjälp av tersbandsdiagram (Assessment of rail roughness in third-octave bands; in Swedish), Report BVH 1588, *Banverket*, Borlänge (Sweden) 2008, 28 pp

4. Jan Spännar: A new approach of assessing rail roughness, *Proceedings 4th International Conference on Railway Condition Monitoring*, Derby (UK) June 2008, 5 pp

5. Jens Nielsen, Oskar Lundberg and Nicolas Renard: Performance report of applied measures – Malmö – in-field measurements of the influence of combined wheel and rail damping on railway noise, Deliverable 5.9, part 1 / QCITY, *EU Sixth Framework Programme*, Contract no TIP4-CT-2005-516420, 41 pp and 2 appendices

6. Jens Nielsen, Oskar Lundberg and Nicolas Renard: Performance report of applied measures – Malmö – in-field measurements of the influence of low barrier on railway noise, Deliverable 5.9, part 2 / QCITY, *EU Sixth Framework Programme,* Contract no TIP4-CT-2005-516420, 23 pp and 1 appendix

7. Jens Nielsen: Rullningsljud – FUD-projekt vid Banverket 2005-2008 (Rolling noise – Banverket's research projects 2005-2008; in Swedish), Research Report 2009:05, *Chalmers Applied Mechanics*, Gothenburg 2009, 30 pp

8. Jan Spännar: Measured rail corrugation growth, *Proceedings 8th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2009)*, Florence (Italy) September 2009, vol 2, pp 429-432

SP11. Vertical contact forces of high-speed trains

1. Anders Johansson: Rail roughness measurements, rail grinding strategies and numerical simulations of rail roughness growth – a literature survey, Research Report 2006:03, *Chalmers Applied Mechanics*, Gothenburg 2006, 20 pp

2. Jens Nielsen: High-frequency vertical wheel-rail contact forces – validation of a prediction model by field testing, *Proceedings 7th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2006)*, Brisbane (Australia) September 2006, vol 1, pp 41-48 (also listed as TS8:7)

3. Per Gullers, Lars Andersson and Roger Lundén: High-frequency vertical wheel/rail contact forces – field measurements and influence of track irregularities, *ibidem*, pp 137-143

4. Jens Nielsen, Anders Ekberg and Roger Lundén: Influence of short-pitch wheel/rail corrugation on rolling contact fatigue, *IMechE Journal of Rail and Rapid Transit*, vol 219, no F3, 2005, pp 177-187 (also listed as TS8:4 and MU9:18). In July 2006 this paper obtained the *IMech E Railway Division W A Agnew / C N Goodall Award 2005*

5. Anders Ekberg, Elena Kabo, Jens Nielsen and Roger Lundén: Subsurface initiated rolling contact fatigue of railway wheels as generated by rail corrugation, *International Journal of Solids and Structures,* vol 44, no 24, 2007, pp 7975-7987 (also listed as TS8:11, MU10:9 and MU22:1)

6. Anders Ekberg and Elena Kabo: The influence of vertical load transients on wheel and rail deterioration, Research Report 2007:12, *Chalmers Applied Mechanics*, Gothenburg 2007, 20 pp

7. Elena Kabo and Anders Ekberg: Index for real-time prediction of sub-surface initiated rolling contact fatigue in railway wheels, Research Report 2007:13, *Chalmers Applied Mechanics,* Gothenburg 2007, 12 pp

8. Jens Nielsen: Rail roughness level assessment based on high-frequency wheel-rail contact force measurements, presented at *9th International Workshop on Railway Noise (IWRN9)* in Feldafing/Munich (Germany) September 2007. With an abbreviated version in *Notes on Numerical Fluid Mechanics and Multidisciplinary Design*, vol 99 (Noise and Vibration Mitigation for Rail Transportation Systems), *Springer*, Berlin 2008, pp 355-362 (also listed as EU10:5)

9. Jens Nielsen: High-frequency vertical wheel-rail contact forces – validation of a prediction model by field testing, *Wear*, vol 265, nos 9-10, 2008, pp 1465-1471 (revised article from conference *CM2006*. Also listed as TS8:10)

10. Per Gullers, Lars Andersson and Roger Lundén: High-frequency vertical wheel-rail contact forces – field measurements and influence of track irregularities, *Wear*, vol 265, nos 9-10, 2008, pp 1472-1478 (revised article from conference *CM2006*)

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12. Per Gullers, Paul Sundvall, Jens Nielsen, Anders Ekberg and Lars Andersson: Track condition analyser – assessment of need for track maintenance based on instrumented wheelset measurements, *Proceedings 16th International Wheelset Congress (IWC16)*, Cape Town (RSA) March 2010, 12 pp

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15. Per Gullers, Lars-Ove Jönsson and Jens Nielsen: Vertikala kontaktkrafter vid trafikering med höghastighetståg på banor för blandad trafik – analys av Gröna Tåget-mätningar (Vertical contact forces for high-speed trains running on tracks with mixed traffic – analysis of Green Train measurements; in Swedish), Document TS3247-0000-5-RES, *Interfleet Technology AB*, Stockholm/Solna 2010, 42 pp + 19 supplementary appendices

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SP12. New sleeper specifications

1. Rikard Bolmsvik and Jens Nielsen: Dimensionerande böjmoment i sliprar vid 35 tons axellast (Dimensioning bending moments in sleepers for axle load 35 tonnes; in Swedish), Research Report 2006:9, *Chalmers Applied Mechanics*, Gothenburg 2006, 44 pp

SP13. Alarm limits for wheel damage

1. Jens Nielsen, Elena Kabo and Anders Ekberg: Larmgräns för hjulskadedetektorer – en utredning av risk för rälbrott på Malmbanan (Alarm limit for wheel damage detectors – an investigation of risk of rail fracture on the Iron Ore Line; in Swedish), Research Report 2007:05, *Chalmers Applied Mechanics*, Gothenburg 2007, 40 pp

2. Jens Nielsen, Anders Ekberg and Elena Kabo: Alarm limits for wheel flats, *15th Nordic Seminar on Railway Technology*, Hook (Sweden) May 2008, 1+27 pp (Summary and PowerPoint presentation)

3. Elena Kabo, Anders Ekberg and Jens Nielsen: Analysis of static fractures of rails due to wheel flats, Research Report 2009:01, *Chalmers Applied Mechanics*, Gothenburg 2009, 18 pp

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5. Anders Ekberg, Elena Kabo and Jens Nielsen: Alarm limits for wheel-rail impact loads, part 2: analysis of crack growth and fracture, Research Report 2009:03, *Chalmers Applied Mechanics,* Gothenburg 2009, 49 pp

SP14. Particle emissions and noise from railways

1. Erik Fridell, Martin Ferm, Anders Björk and Anders Ekberg: Emissions of particulate matter from railways – onboard and tunnel measurements, *IVL Swedish Environmental Research Institute*, Report B1892, Stockholm 2009, 42 pp

2. Erik Fridell, Martin Ferm and Anders Ekberg: Emissions of particulate matters from railways – emission factors and condition monitoring, *Transportation Research Part D: Transport and Environment*, vol 15, no 4, 2010, pp 240–245

3. Erik Fridell, Anders Björk, Martin Ferm and Anders Ekberg: On-board measurements of particulate matter emissions from a passenger train, *IMechE Journal of Rail and Rapid Transit*, vol 225, no F1, 2011, pp 99-106

SP15. Computer program for design of block brakes

1. Tore Vernersson: Tread braking of railway wheels – dimensioning wheel temperatures, Software manual version 1.0, *Chalmers Applied Mechanics / CHARMEC*, Gothenburg 2008, 45 pp

SP16. Identification of dynamic properties in track of timber sleepers and concrete replacement sleepers

1. Nico Burgelman: Concrete sleeper tuned to replace a timber sleeper, MSc Thesis 2009:38, *Chalmers Applied Mechanics*, Gothenburg 2009, 52 pp. Author received Swedtrain's prize for Best Master's Thesis 2009

2. Anders Ekberg and Elena Kabo: Timber replacement sleepers – ensuring lateral track stability, Research Report 2010:10, *Chalmers Applied Mechanics,* Gothenburg 2010, 11 pp

SP17. Switch sleeper specifications

1. Per Kron: Static structure analysis of a turnout, *Epsilon UC Väst AB*, Report 510610-01, Gothenburg 2009, 78 pp

2. Per Kron: Static and dynamic structure analysis of a turnout, *Epsilon UC Väst AB,* Report 510610-02, Gothenburg 2009, 34 pp

3. Per Kron: Dynamic structure analysis of a turnout, *Epsilon UC Väst AB,* Report 510610-03, Gothenburg 2010, 49 pp

4. Rikard Bolmsvik, Jens Nielsen, Per Kron and Björn Pålsson: Switch sleeper specification, Research Report 2010:03, *Chalmers Applied Mechanics*, Gothenburg 2010, 54 pp (also listed as TS13:4)

SP18. Ground vibrations from railway traffic − a prestudy on the influence of vehicle parameters

1. Adam Mirza, Anders Frid and Jens Nielsen: Markvibrationer från järnvägstrafik – en förstudie med inriktning på inverkan av fordonsparametrar (Ground vibrations from railway traffic – a prestudy aiming at the influence of vehicle parameters; in Swedish), Research Report 2010:08, *Chalmers Applied Mechanics*, Gothenburg 2010, 44 pp

2. Adam Mirza, Anders Frid, Jens Nielsen and Chris Jones: Ground vibration induced by railway traffic – the influence of vehicle parameters, *Proceedings 10th International Workshop on Railway Noise (IWRN10),* Nagahama (Japan) October 2010, pp 245-252. Abbreviated version in *Notes of Numerical Fluid Mechanics and Multidisciplinary Design*, vol 118, *Springer*, Berlin 2012, pp 259-266

3. Adam Mirza, Anders Frid and Jens Nielsen: Ground vibrations from high speed trains on Swedish soil – a first look at the influence of rolling stock parameters, *16th Nordic Seminar on Railway Technology*, Nynäshamn (Sweden) September 2010, 1+23 pp (Summary and PowerPoint presentation)

SP19. Optimum track stiffness

1. Jens Nielsen: Optimum vertical track stiffness – a literature survey, Research Report 2010:01, *Chalmers Applied Mechanics*, Gothenburg 2010, 30 pp

2. Jens Nielsen: Optimum vertical track stiffness, Research Report 2010:11, *Chalmers Applied Mechanics,* Gothenburg 2010, 63 pp

SP20. Classification of wheel damage forms

1. Anders Ekberg and Elena Kabo: Klassifiering av hjulskador (Classification of wheel damage; in Swedish), Research Report 2011:12, *Chalmers Applied Mechanics*, Gothenburg 2011, 7 pp

2. Anders Ekberg and Elena Kabo: Classification of wheel damage, Research Report 2011:13, *ibidem*, Gothenburg 2011, 7 pp

SP21. Optimum material selection for switches

1. Elena Kabo, Magnus Ekh and Jens Nielsen: Prediction of crossing nose profile degradation in a railway turnout, Research Report 2012:6, *Chalmers Applied Mechanics,* Gothenburg 2012, 34 pp (and 2 annexes, 6+6 pp)

2. Elena Kabo and Anders Johansson: User manual for simulations in the project “Optimum material selection for track switches”, Research Report 2012:9, *Chalmers Applied Mechanics,* Gothenburg 2012, 16 pp

SP22. Implementing INNOTRACK results at Trafikverket

1. Anders Ekberg and Björn Paulsson (editors): INNOTRACK – Sammanfattning av avslutande teknisk rapport (INNOTRACK – Summary of Concluding Technical Report; in Swedish), *UIC*, Paris 2010, 10 pp (also listed as EU10:22)

2. Anton Wahnström: Validation of insulated joints, MSc Thesis 2011:4, *Chalmers Applied Mechanics*, Gothenburg 2011, 34 pp

3. Johan Sandström, Elena Kabo, Arne Nissen, Fredrik Jansson, Anders Ekberg and Roger Lundén: Deterioration of insulated rail joints – a three-year field study, *Proceedings 9th International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM2012),* Chengdu (China) August 2012, pp 301-308 (also listed as MU18:15)

SP23. Optimized prestressed concrete sleeper

1. Rikard Bolmsvik, Jens Nielsen and A K Singhal: Guideline for design optimization and production of prestressed concrete railway sleepers, Research Report 2011:5, *Chalmers Applied Mechanics*, Gothenburg 2011, 82 pp (and 6 appendices, 3+1+1+32+1+8 pp)

SP24. Derailment risks in switches

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SP25. Harmonized measurement sites for track forces

1. HRMS: Harmonization – Running behaviour and noise on measurement sites, *UIC*, 2014, 153 pp. Chalmers responsible for Section 3.2 “Categorization of measurement sites – limit values, assessment concepts” and partly responsible for Section 3.3 “Reproducibility of noise measurements”

SP26. Holistic optimization of tracks

1. Jens Nielsen, Eric Berggren, Rikard Bolmsvik, Anders Hammar and Thomas Axelsson: Track geometry degradation and optimisation of sleeper support conditions on the Swedish iron ore line, *Proceedings Railway Engineering 2015*, Edinburgh (UK) June – July 2015, 12 pp (available on CD)

SP27. Optimized prestressed concrete sleeper – phase II

1. Rikard Bolmsvik and Jens Nielsen: Optimization of railway concrete sleeper design, Research Report 2014:07, *Chalmers Applied Mechanics*, Gothenburg 2014, 97 pp

SS. Some selected additional publications

The works listed below all have a bearing on the railway mechanics research at Chalmers University of Technology and they were published both before and after the start of CHARMEC in July 1995

1. Roger Lundén: Järnvägshjul med krympförband − beräkningar och experiment för verifiering av toleranser (Railway wheels with shrink-fit assembly − calculations and experiments to verify tolerances; in Swedish), Research Report F110, *Chalmers Solid Mechanics*, Gothenburg 1988, 39 pp

2. Roger Lundén: Fatigue durability of tread-braked railway wheels − on admissible combinations of axle load, train speed and signalling distance, *IMechE Journal of Rail and Rapid Transit*, vol 205, no F1, 1991, pp 21-33

3. Mikael Fermér and Roger Lundén: Transient brake temperatures found by use of analytical solutions for finite hollow cylinders, *IMechE Journal of Mechanical Engineering Science,* vol 205, no C3, 1991, pp 189-200

4. Jens Nielsen: Eigenfrequencies and eigenmodes of beam structures on elastic foundation, *Journal of Sound and Vibration*, vol 145, no 3, 1991, pp 479-487

5. Jens Nielsen and Thomas Abrahamsson: Complex eigensolutions used for beam structures on elastic foundation loaded by moving nonlinear dynamic systems, *Proceedings IXth International Modal Analysis Conference (IMAC IX)*, Florence (Italy) April 1991, vol 2, pp 1110-1116

6. Tore Dahlberg and Jens Nielsen: Dynamic behaviour of free-free and in-situ concrete railway sleepers, *Proceedings International Symposium on Precast Concrete Railway Sleepers,* Madrid (Spain) April 1991, pp 393-416. See also Research Report F138, *Chalmers Solid Mechanics,* Gothenburg 1991, 17 pp

7. Jens Nielsen and Thomas Abrahamsson: Coupling of physical and modal components for analysis of moving non-linear dynamic systems on general beam structures**,** *International Journal for Numerical Methods in Engineering,* vol 33, no 9,1992, pp 1843-1859

8. Åsa Fenander and Annika Igeland: Nonlinear vehicles on randomly profiled tracks − Monte Carlo simulation of excitation and frequency analysis of response, Research Report T127, *Chalmers Solid Mechanics,* Gothenburg 1991, 21 pp

9. Roger Lundén: Contact region fatigue of railway wheels under combined mechanical rolling pressure and thermal brake loading, *Wear*, vol 144, nos 1-2, 1991, pp 57-70. This issue of Wear constitutes *Proceedings 3rd International Conference on Contact Mechanics and Wear of Rail/Wheel Systems (CM1990)*, Cambridge (UK) July 1990

10. Mikael Fermér: Brake discs for passenger trains − a theoretical and experimental comparison of temperatures and stresses in solid and ventilated discs, *IMechE Journal of Rail and Rapid Transit*, vol 206, no F1, 1992, pp 37-46

11. Mikael Fermér: Flexible wheels for railway freight cars considering thermal and mechanical aspects of block braking, *Proceedings 10th International Wheelset Congress (IWC10)*, Sydney (Australia) September - October 1992, pp 277-281

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