



The 15th International Conference on

# Magnetically Levitated Systems and Linear Drives

## ***MAGLEV '98***

12th-15th April, 1998, Mt. Fuji, Japan

**Sponsored by**

The Institute of Electrical Engineers of Japan(Industry Applications  
Society: Technical Committees on Linear Drives & Transportation and  
Electric Railway)

**Cosponsored by**

The Japan Society of Mechanical Engineers  
The Japan Society of Civil Engineers

**Supported by**

Ministry of Transport, Japan

**In cooperation with**

IEEE Tokyo Chapter on Vehicular Technology Society  
Japan Railway Engineer's Association  
Japan Subway Association  
Railway Electrical Engineering Association of Japan  
Yamanashi Prefecture

## **Organizing Committee**

Chairperson: MASADA, Eisuke (The University of Tokyo)  
Members: EBIHARA, Daiki (Musashi Institute of Technology)  
FUJINO, Masaaki (Chubu HSST Development Corp.)  
FUJIWARA, Shunsuke (Railway Technical Research Institute)  
HASHIMOTO, Fumio (Kyosan Electric Mfg. Co., Ltd.)  
IKEDA, Kenji (West Japan Railway Co.)  
ISHIMIZU, Yoshinao (Yamanashi Prefecture)  
ISOURA, Katsutoshi (Central Japan Railway Co.)  
IWAKURA, Tamon (Japan Subway Association)  
KAWAI, Isao (Toshiba Corp.)  
KAWASHIMA, Yasuji (HSST Development Corp.)  
KOMORI, Hiroshi (Japan Railway Construction Public Corp.)  
MATSUMURA, Fumio (Kanazawa University)  
NAITO, Hiroji (Hitachi, Ltd.)  
NARUTO, Masaji (Mitsubishi Electric Corp.)  
SAKAGUCHI, Tsutomu (Railway Electrical Engineering Association of Japan)  
SASAKI, Toshiaki (Railway Technical Research Institute)  
SEKI, Akio (Central Japan Railway Co.)  
SHIMADA, Takefumi (Railway Technical Research Institute)  
TAKEI, Hidetoshi (Toyo Electric Mfg. Co., Ltd.)  
YAMASHITA, Hiroyuki (Ministry of Transport)  
YOSHIBA, Hiroyuki (Japan Railway Engineer's Association)  
YOSHIDA, Yasutomo (Mitsubishi Heavy Industries, Ltd.)  
Secretaries: KITANO, Jun-ichi (Central Japan Railway Co.)  
KOSEKI, Takafumi (The University of Tokyo)

## **International Steering Committee**

Chairperson: MASADA, Eisuke (The Univ. of Tokyo, Japan)  
Members: EASTHAM, Tony (The Hong Kong University of Science and Technology, China)  
MORINI, Augusto (Universita degli Studi di Padova, Italy)  
PASCAL, Jean Piere (INRETS, France)  
ROGG, Dieter (Dornier System Consult GmbH, Germany)  
ROTE, Donald M. (Argonne National Laboratory, USA)  
WEH, Herbert (Technische Universität Braunschweig, Germany)

## **Steering Committee**

Chairperson: FUJIWARA, Shunsuke (Railway Technical Research Institute)  
Members: KITANO, Jun-ichi (Central Japan Railway Co.)  
NAKAO, Hiroyuki (Toshiba Corp.)  
MAKINO, Fumitaka (Mitsubishi Electric Corp.)  
MIYAIRI, Koumei (Hitachi, Ltd.)  
MIZUMA, Takeshi (Traffic Safety and Nuisance Research Inst.)  
MURAI, Munenobu (HSST Development Corp.)  
TAKASE, Shunji (Kyosan Electric Mfg. Co., Ltd.)  
TERAI, Motoaki (Central Japan Railway Co.)  
WATADA, Masaya (Musashi Inst. of Tech.)  
Secretaries: HAYASHIYA, Hitoshi (The Univ. of Tokyo)  
KOSEKI, Takafumi (The Univ. of Tokyo)  
MURAI, Toshiaki (Railway Technical Research Institute)  
Advisor: MASADA, Eisuke (The Univ. of Tokyo)

# Table of Contents

## **Keynote Speech**

KN-1	Overview of the Several Linear Drive Transport Systems in Japan <i>(Ministry of Transport, Japan)</i>	1
KN-2	The Transrapid---a Futuristic Technology about to Become a Part of Today's Transport System <i>E. A. Marburger (Ministry of Transport, Germany)</i>	2
KN-3	American View <i>(Federal Railroad Administration, U.S.A)</i>	

## **Plenary Session**

PL-1	Development of the Maglev System in Japan : Past, Present and Future -- <i>H. Soejima (Railway Technical Research Inst., Japan), K. Isoura (Central Japan Railway Co., Japan)</i>	8
PL-2	DB AG - First Customer of the Transrapid in Germany <i>R. Heinisch (Deutsche Bahn AG, Germany)</i>	12
PL-3	The German Superspeed Maglev System Transrapid and the System Suppliers Adtranz, Siemens and Thyssen <i>G. Wahl, H. G. Raschbichler (Transrapid International, Germany)</i>	15
PL-4	SwissMetro Project <i>M. Jufer (Swiss Federal Inst. of Tech., Switzerland)</i>	

## **Session 1 <World Wide Developments>**

S1-1	System Characteristics of the Transrapid Superspeed Maglev System <i>L. Miller, F. Löser (Thyssen Transrapid System GmbH, Germany)</i>	19
S1-2	Superconducting Maglev Development in Japan <i>H. Nakashima (Railway Technical Research Inst., Japan), K. Isoura (Central Japan Railway Co., Japan)</i>	25
S1-3	Linear Drive Systems for Urban Transportation in Japan <i>H. Ohsaki (The Univ. of Tokyo, Japan)</i>	29
S1-4	Status of the Maglev Development in Korea <i>I. K. Kim, M. H. Yoo (Korea Inst. of Machinery and Materials, Korea), K. H. Han, G. S. Park, H. S. Bae (Hyundai Precision and Ind. Co.,Ltd, Korea)</i>	34

## **Session 2 <High Speed Transport Project 1>**

S2-1	The Transrapid Berlin-Hamburg Project: Status-Report on Planning, Financing and Project Structures <i>H. C. Atzpodien (Magnetschnellbahn-Planungsgesellschaft mbH, Germany)</i>	39
S2-2	Update of the Transrapid Project between Berlin and Hamburg <i>H. Fricke (Magnetschnellbahn-Planungsgesellschaft mbH, Germany)</i>	45
S2-3	Outline of Yamanashi Maglev Test Line and Test Schedule <i>Y. Osada, H. Gotou (Central Japan Railway Co. Ltd., Japan), K. Sawada, F. Okumura (Railway Technical Research Inst., Japan)</i>	50
S2-4	Current Test Status of the Superconducting Maglev System on the Yamanashi Test Line <i>H. Kurobe, K. Kaminishi (Railway Technical Research Inst., Japan), S. Miyamoto, A. Seki (Central Japan Railway Co., Japan)</i>	56

## **Session 3 <Urban Transport Project>**

S3-1	The Results of Running Test of the HSST-100L Vehicle <i>M. Tanaka, M. Fujino (Chubu HSST Development Corp., Japan), M. Murai(HSST Development Corp., Japan)</i>	62
S3-2	Otis Hovair Transit System <i>P. Y. Kim (Nippon Otis Elevator Co., Japan)</i>	68
S3-3	Performance Test of the Urban Transit Maglev Vehicle (UTM-01) in Korea <i>H. J. Cho, J. M. Lee (Korea Inst. of Machinery and Materials, Korea), K. J. Kim (Hyundai Precision &amp; Ind. Co.,Ltd, Korea)</i>	72
S3-4	Development on Linear Metro System <i>T. Okunuki, M. Ando, S. Amikura, T. Taguchi, S. Oyama (Japan Subway Association,</i>	

Japan) 78

#### **Session 4 <High Speed Transport Project 2>**

S4-1	The Transrapid Maglev Berlin-Hamburg Operating Concept <i>J. Keil (Deutsche Bahn AG, Germany)</i>	83
S4-2	Certification Program for the Berlin-Hamburg Transrapid <i>L. Baur (MVP Versuchs- und Planungsgesellschaft für Magnetbahnsysteme mbH, Germany), J. Böhlke (Federal Railway Office, Germany), H. Jansen (ATT-TÜV Rheinland, Germany)</i>	86
S4-3	Control & Maintenance Facilities of the Maglev System Berlin-Hamburg <i>C. D'Souza, U. Steenbeck (ABB Daimler-Benz Transportation GmbH, Germany)</i>	92
S4-4	Transrapid Test Facilities in Emsland (TVE) from Components Testing to System Operation <i>J. Metzner (Industrieanlagen-Betriebsgesellschaft mbH, Germany)</i>	101
S4-5	The Transrapid Test Facility in Emsland (TVE) <i>H. P. Friedrich (MVP Versuchs- und Planungsgesellschaft für Magnetbahnsysteme mbH, Germany)</i>	106
S4-6	Verification of the Environmental Compatibility of the Transrapid <i>C. Wolters, K. P. Schmitz (Industrieanlagen-Betriebsgesellschaft mbH, Germany)</i>	110
S4-7	Electromechanical Aspects of the Swissmetro Pilot Track Geneva -Lausanne <i>A. Cassat, N. Macabrey, M. Jufer (Swiss Federal Inst. of Tech. Lausanne, Switzerland)</i>	116

#### **Session 5 <Linear Motor>**

S5-1	The Influence of Electro-Magnetic Field by Linear Driven Systems to Environment <i>T. Mizuma (Traffic Safety and Nuisance Research Inst., Japan)</i>	122
S5-2	Evaluation of Noise Reduction on HSST-100L Vehicle with Installation of IGBT Inverter <i>S. Ogata, T. Tanaka (Traffic Safety and Nuisance Research Inst., Japan), T. Kiyohara (HSST Development Co., Japan), M. Tanaka (Chubu HSST Development Co., Japan)</i>	126
S5-3	Experimental LIM Propulsion System for Estimation of Safety <i>K. Tashiro, M. Morizumi (Hitachi, Ltd., Japan), T. Mizuma (Traffic Safety and Nuisance Research Inst., Japan)</i>	132
S5-4	The Brake System of PM-LSM Driven System <i>T. Mizuma, H. Ohno (Traffic Safety and Nuisance Research Inst., Japan), J. Hamamoto, K. Nakamura (Kobe Steel, Company, Japan)</i>	136
S5-5	Adoption of Linear Motor Propulsion System for Subway (Osaka Subway Line No.7; Nagahori Tsurumi-Ryokuchi Line) <i>S. Teraoka (Osaka Municipal Transportation Bureau, Japan)</i>	140
S5-6	Outline of Tokyo Subway Line No. 12: Linear Motor Driven Electric Subway Car <i>T. Horiuchi, N. Fujimura, Y. Murai (Transportation Bureau of Tokyo Metropolitan Government, Japan)</i>	146
S5-7	Linear Motor Driven Car of the Kaigan Line, Kobe Municipal Subway <i>M. Tajiri, M. Yoshida (Kobe Municipal Transportation Bureau, Japan)</i>	152

#### **Session 6 <Guideway>**

S6-1	Guide ways for Transrapid ; The Guideway in Its Modular Form <i>E. Grossert (IBF GmbH, Germany)</i>	158
S6-2	Transrapid Guideway : Technical Standards <i>G. Schwindt (Thyssen Transrapid System GmbH, Germany)</i>	166
S6-3	The Steel Guideway for the Maglev System Transrapid <i>O. Rodriguez (Stahlbau Lavis GmbH, Germany)</i>	172
S6-4	Guide ways and Structures on the Yamanashi Maglev Test Line and Their Dynamic Response Characteristics <i>M. Yamazaki, Y. Gotou, S. Aoki (Central Japan Railway Co., Japan), S. Hashimoto, M. Sogabe (Railway Technical Research Inst., Japan), T. Itou (Japan Railway Construction Public Corp., Japan)</i>	178

#### **Session 7 <Train Control>**

S7-1	Train Control Characteristic and the Function of the Position Detecting System at Yamanashi Maglev Test Line <i>M. Ono, Y. Sakuma, H. Adachi, K. Hanamoto (Central Japan Railway Co., Japan), T. Watanabe, Y. Sakai, S. Sasaki (Railway Technical Research Inst., Japan), Y. Yokota (The Nippon Signal Co., Ltd, Japan), S. Uchida (Kyosan Electric Mfg. Co., Ltd., Japan)</i>	184
------	---	-----

S7-2	Vehicle Command / Control, and On-Line Diagnosis for Automatic Operation of the Superspeed Maglev System Transrapid <i>W. Fischer, C. Lukasch (Thyssen Transrapid System GmbH, Germany)</i>	190
S7-3	Operations Control System Transrapid Berlin-Hamburg <i>S. Burkert, R. T. Materne (Siemens AG, Germany)</i>	196

### **Session 8 <Maglev Vehicle & Dynamics>**

S8-1	Requirements, Design and Characteristics of the Maglev Vehicle Transrapid 08 <i>K. Wegerer, P. Becker, S. Ellmann, W. Hahn (Thyssen Transrapid System GmbH, Germany)</i>	202
S8-2	Mechanical Structure of the Vehicle Transrapid 08 <i>J. Ebmeyer, S. Kunz (Thyssen Transrapid System GmbH, Germany), R. J. Dean, J. Wieschermann (Alusuisse Road &amp; Rail AG, Switzerland)</i>	209
S8-3	Design Criteria of the On-Board Linear Generator Winding in EMS-Maglev Systems <i>M. Andriollo, G. Martinelli, A. Morini, A. Tortella (Univ. of Padova, Italy)</i>	214
S8-4	Outline of the Second Train Set for the Yamanashi Maglev Test Line <i>T. Kitamori, A. Inoue (Central Japan Railway Co., Japan), M. Yoshimura, Y. Matsudaira (Railway Technical Research Inst., Japan), S. Hosaka (Central Japan Railway Co., Japan)</i>	220
S8-5	Results of Running Tests and Characteristics of the Dynamics of the MLX01 Yamanashi Maglev Test Line Vehicles <i>H. Yoshioka, E. Suzuki, H. Seino, M. Azakami (Railway Technical Research Inst., Japan), H. Oshima, T. Nakanishi (Central Japan Railway Co., Japan)</i>	225
S8-6	A Review of Dynamic Stability of Repulsive-Force Maglev Suspension Systems <i>Y. Cai, D. M. Rote (Argonne National Lab., U.S.A.)</i>	231

### **Session 9 <Superconducting Coil & Linear Generator>**

S9-1	Characteristics of Superconducting Magnets and Cryogenic System on Yamanashi Test Line <i>H. Tsuchishima, T. Mizutani, T. Okai, M. Nakauchi (Railway Technical Research Inst., Japan), M. Terai, S. Inadama, T. Asahara (Central Japan Railway Co., Japan)</i>	237
S9-2	Vibration Characteristics and Mechanical Heat Load of Superconducting Magnets of Maglev Trains <i>T. Yamaguchi, Y. Jizo, H. Akagi (Mitsubishi Electric Corp., Japan), M. Terai, M. Igarashi, M. Shinobu (Central Japan Railway Co., Japan)</i>	244
S9-3	Development of the New Type On-Board GM Refrigeration System for the Superconducting Magnet in Maglev Use <i>H. Nakao, M. Takahashi, Y. Sanada, T. Yamashita, M. Yamaji, A. Miura (Toshiba Co., Japan), M. Terai, M. Igarashi (Central Japan Railway Co., Japan), T. Kurihara, K. Tomioka (Daikin Industries Ltd., Japan)</i>	250
S9-4	Experimental Result of the Superconducting Magnet Artificial Damage Test at the Miyazaki Maglev Test Track <i>M. Iwamatsu, K. Watanabe, S. Saitou, A. Kishikawa (Railway Technical Research Inst., Japan)</i>	256
S9-5	Development of Linear Generators for Superconducting Maglev <i>T. Murai, S. Fujiwara, H. Hasegawa, K. Nemoto (Railway Technical Research Institute, Japan), H. Watanabe, Y. Furukawa (Hitachi Ltd., Japan), M. Shinobu, M. Igarashi, S. Inadama (Central Japan Railway Company, Japan), H. Akagi, M. Oki (Mitsubishi Electric Corp., Japan)</i>	262
S9-6	Contactless Power Supply for Transport Systems <i>J. Meins (Technische Universität Braunschweig, Germany)</i>	268

### **Session 10 <Power Supply & Ground Coil>**

S10-1	Long Stator Propulsion System of the Transrapid Berlin-Hamburg <i>U. Henning (Siemens AG, Germany)</i>	274
S10-2	SWISSMETRO-Power Supply for a High-Power Propulsion System with Short Stator Linear Motors <i>M. Rosenmayr, A. Cassat, H. Glavitsch, H. Stemmler (The Swiss Federal Inst. of Tech. Zürich, Switzerland)</i>	280
S10-3	Driving Control Characteristic Using the Inverter System at Yamanashi Maglev Test Line <i>M. Hashimoto, J. Kitano, K. Inden, H. Tanitsu (Central Japan Railway Co., Japan), I. Kawaguchi, S. Kaga, T. Nakashima (Railway Technical Research Inst., Japan), S. Koike (Hitachi, Ltd., Japan), Y. Mugiya (Toshiba Corp., Japan), H. Sogihara (Mitsubishi Electric Corp., Japan)</i>	287
S10-4	Features of Ground Coils for Yamanashi Maglev Test Line	

- H. Suwa (Railway Technical Research Inst., Japan), H. Turuga (Central Japan Railway Co., Japan), T. Iida (Japan Railway Construction Public Corp., Japan), S. Tujimoto (Hitachi Corp., Japan), Y. Kobayashi (Toshiba Corp., Japan), Y. Itabashi (Mitsubishi Electric Corp., Japan)* 292
- S10-5 An Integrated Maglev System  
*K. Davey, T. Morris (American MAGLEV, U.S.A.), D. Rote (Argonne National Lab., U.S.A.), R. Zowarka (CEM, U.S.A.)* 297

### **Session 11 <EMS Technology>**

- S11-1 Control Strategies for the Electromagnetic Levitated and Guided Vehicles of SwissMetro  
*S. Colombi, A. Rufer (Swiss Federal Inst. of Tech. Lausanne, Switzerland), M. Zayadine, M. Girardin (Warner Electric Int. SA, Switzerland)* 306
- S11-2 Levitation & Guidance Control Design and Its Application to UTM-01  
*C. K. Kim, K. H. Kim, J. M. Kim (Korea Electrotechnology Research Inst., Korea), H. K. Sung (Korea Inst. of Machinery and Metals, Korea), J. S. Lee (Hundai Precision & Ind. Co., Ltd, Korea)* 312
- S11-3 An Experimental Study to Improve the Magnet Performance for Korean Maglev Test Vehicle (UTM)  
*B. S. Kim, H. K. Chung, M. W. Yoo (Korea Inst. Machinery and Materials, Korea), B. G. Kang (Hyundai Precision & Ind. Co.,Ltd, Korea)* 318
- S11-4 EMS Maglev Suspension Control System Comparison and Trends  
*J. E. Paddison (Knorr-Bremse Systeme für Schienen Fahrzeuge, Germany), R. M. Goodall (Loughbrough Univ., U.K.)* 324
- S11-5 Sizing and Performance Comparative Analysis of Field-Levitation Devices for EMS Maglev Transportation Systems  
*F. C. Dezza, A. D. Gerlando, I. Vistoli (Politecnico di Milano, Italy)* 330
- S11-6 EMS Maglev Using High Temperature Superconducting Coils  
*R. M. Goodall (Loughbrough Univ., U.K.), H. Jones (Univ. of Oxford, U.K.), A. M. Campbell (Univ. of Cambridge, U.K.)* 336

### **Session 12 <Social & Economic Matter>**

- S12-1 The Megaproject Transrapid, from Technical Concept to Commercial Application, Reasons for Support from the German Federal Government  
*M. Witt (Federal Ministry for Education, Science, Research and Technology, Germany), D. Rogg (Dornier System Consult GmbH, Germany)* 342
- S12-2 High Speed Rail and Maglev : Complementary or Competition?  
*T. R. Eastham (The Hong Kong Univ. of Science and Technology, China)* 348
- S12-3 The Superspeed Maglev System Transrapid : Market Opportunities and Potential  
*M. Wackers, R. Budell (Transrapid International, Germany)* 352
- S12-4 Comparison of High-Speed Rail and Maglev System Costs  
*D. M. Rote (Argonne National Lab., U.S.A.)* 357