Maglev Systems as you can touch

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Abstract

This multimedia presentation shows maglev systems (Transrapid TR09, SupraTrans) during operation on a test track in 3D Stereo. During the presentation, appropriate 3D glasses are handed out. The presentation is intended to be a counterpart to the numerous scientific and highly technically qualified oral presentations and a break in between them.

1. Introduction

Stereopsis describes the ability of human beings and different animals to gather perception of depth and 3-dimensional structure from visual information of two eyes at slightly different positions. It enables us to discern that things in our world are such like that „you can touch“ them and they not are not flat, as seeing with a single eye would effect.

Stereopsis has been used for many years in research institutes and in the aircraft, space and car industries for visualization and better understanding of complex structures like organic molecules and high tech CAD models. Meanwhile, 3D stereoscopy devices, such as 3D TV, consoles and beamers are commonly introduced on the consumer market, so that schools can use stereopsis for better e-learning experience.

Scientific research has shown that viewing 3D stereo pictures or videos leaves a more sustainable impression than those provided in 2D. The neuroscientist and digital imaging expert, Dr. Barry Sandrew, regards 3D stereo videos to promote environmental intelligence (or awareness) and pointed out that these transform “the movie screen into an exquisitely open window that has both an interior and an exterior, enveloping the entire theater” which can have the effect that “the space both in front of and behind the movie screen becomes an integral part of the story and the message” [1].

As an outlook, this effect could be enhanced by adding an interactive component to presentations of 3D stereo picture material such as that applied in a cyberclassroom (CC) at schools. These can improve learning in sciences, technology, engineering and mathematics (STEM) under certain circumstances, which are explained in [2].

Showing maglev systems promotes environmental awareness because these systems enable sustainable, non-intrusive traffic by reduction of environmental impact and waste of mineral deposits by the renewal of worn out materials. The following presentation shows some of these in operation as described in the following chapters.

2. A roundtrip with the Transrapid TR09 maglev

The Transrapid TR09 is the latest and currently last maglev train model that was successfully tested on the Transrapid Test Facility Emsland (TVE) at Lathen, Germany. It was designed for use as a rapid airport link between downtown Munich and the airport instead of long-distance travel of its predecessor TR08. The properties of the TR09 vehicle were the subject of several oral presentations during former Maglev conferences (e.g. [3]).

The first section of TR09 was delivered on April 19, 2007 and the other two sections within a week afterwards. But it took more than a year’s time until permission was given by the authorities to start test operation on July 3, 2008, because a new safety concept had to be worked out. One month later, on August 4, test rides without passengers were started in order to obtain approval of all technical components. Finally, in May of the next year passenger transport was allowed, but unlike for TR06, TR07, and TR08 not for all vis-

itors of TVE. This privilege was reserved for members of business delegations for marketing purposes or groups of technical experts.

On May 29, 2009, a business delegation from Switzerland, which has promoted the SwissRapide project based on Transrapid technology, was the first group to take a ride on the new Transrapid TR09. Seven days later, an international technical expert group under the leadership of Prof. Dr. Johannes Klühspies could experience the advantages of maglev technology while riding the vehicle. As an employee of a company, which represents German rail industry, the author of this paper had the chance to join this group. Some scenes of this video were made on this day with a pair of digital cameras and can be considered genuine. Some other scenes, like the speedometer in operation, were the result of video post-processing because there was no further occasion to participate in a later ride. The first scenes were taken with a pair of digital photo cameras (Panasonic Lumix LX3) with 720p resolution. For later scenes, a rig with two Canon Legria HF S21 with a common remote control unit producing 2x1080i output was used (Fig. 1).

Fig. 1: Transrapid TR09 in front of 3D stereo camera rig (source: GFM-eV).

On November 28, 2011, the last ride of Transrapid TR09 took place with a delegation of consultants of the president of the Isle of Tenerife, Mr. Ricardo Melchior Navarro. Subsequently, the vehicle was decommissioned and has remained so until today. Meanwhile, the linear motor has been removed from the guideway of the test track.

The video plays a vital role, reminding the viewer that Germany successfully realized the first passenger transport with a highly environmentally friendly means of travel, first applied on June 1979, at the International Traffic Exhibition in Hamburg and later on the TVE. The operation of Transrapid in Germany has stopped by reasons which are completely differerent from technical and environmental argumentation.

This video is the first and only high definition 3D stereo video about the Transrapid technology in Germany. It is dedicated to Detlev Schubsky (1953-2006). He was one of the victims of the crash of the Transrapid TR08, where maglev technology was not at fault. Exactly 10 years before this Maglev conference, one week after he participated on Maglev 2006 in Dresden, he contributed to a poster session. Mr. Schubsky (aka. “Mr. Transrapid”) had the ability to concisely explain the maglev technology for many thousands of passengers of Transrapid TR07 and TR08 on the TVE as well as giving good political arguments for the implementation of maglev technology. This enabled the visitors of TVE to become a little bit more fascinated about the Transrapid. Because of his dedication, his voice can be heard during the TR09 ride, even if he was not able to demonstrate the driving operations of this next generation of maglev technology.

After the TVE was closed for Transrapid test operations, the operating company IABG (Industrieanlagen Betriebsgesellschaft mbH) founded a subsidiary company named INTIS (Integrated Infrastructure Solutions), that could keep approximately a third of the highly qualified staff and maintain the technological competence in that region. Transrapid technology had generated two spin-off effects in the area of electric mobility.

The first is the Inductive Power Supply (IPS, see [4]), which allows wireless energy transfer from the guideway into the vehicle. The second spin-off is an adaptation of Stator Section Switching (see [5]), which triggers that only the long stator sections at the current position of the vehicle are electrically energized. Together they form the base of the Dynamic Wireless Power Transfer (DWPT) research project named Wireless Power Road, started with the aid of the German Federal Ministry of Transport and Digital Infrastructure (BMVI) [6].

Fig. 2: Transrapid TR09 behind it's spin-off: the Wireless Power Road test track (source: GFM-eV).

Along a 25m test track, a test vehicle can be moved receiving at each current position 30 kW of electric power, consumed at 15 halogen spotlights along with a heating resistor (Fig. 2). This is enough to move a car along a motorway. For charging trucks, tests can be enhanced up to a transferred power of 200 kW at frequencies of up to 35 kHz. INTIS plans to roll out the first product, at least for stationary charging, in the coming year [7] and is listed as a possible supplier of charging technology in the feasibility study for the powering of electric vehicles on England's major roads [8].

While the further development of Transrapid technology is now suspended, spin-off technology is very alive.

3. SupraTrans Test Facility at Dresden

Since 2004, tests of a new type of magnetic levitation have been carried out.

When in 1911 at the University of Leiden the Dutch physicist Heike Kamerlingh Onnes discovered the phenomenon of superconductivity by cooling down mercury to -269°C with liquid helium, nobody anticipated

the application opportunities, which are being explored 100 years later at the Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden). These include the development of

- wind turbines
- elevators
- maglev trains

and are feasible through the discovery of high temperature superconductors which consist of ceramic materials and were developed during the past 30 years. The video shows the maglev application vehicle SupraTrans I – presented during Maglev 2006 conference – as well as its successor SupraTrans II. It also shows the cooling procedure of the cryostats with liquid nitrogen and a ride on the 80m long circular test track at Dresden-Niedersedlitz during the launch of operations on February 8, 2011 [9]. Nearly three years later, on January 27, 2014 a driveway branch (turnout switch) was integrated into the test track. The purpose was the proof that the driveway can branch and is not exclusively made for a point-to-point connection or round trip transport.

In 2015, the test track was reconstructed with a 4.4 % slope named “bowl” and a quarter pipe with a gradient up to 25 %. The purpose of these guideway elements was to enable feasibility tests for a promotion video containing rides with a hoverboard. In cooperation with the Japanese carmaker Lexus, an individual item of a skateboard was manufactured with a tank for liquid nitrogen to cool down the superconductor (low profile cryostat). After the successful tests of the new track design with a qualified hoverboard rider, the test track moved to Cubelles near Barcelona, Spain in May 2015 for three months. The final tests took place there before the track elements were covered by the skate park surface. Afterwards, a promotion video could be recorded.

When the video shooting was over, the skatepark was dismantled and the test track transported back to Dresden. The “bowl” slope remained to demonstrate the ability of the vehicle to surmount gradients to visitors of the test drive facility SupraTrans II.

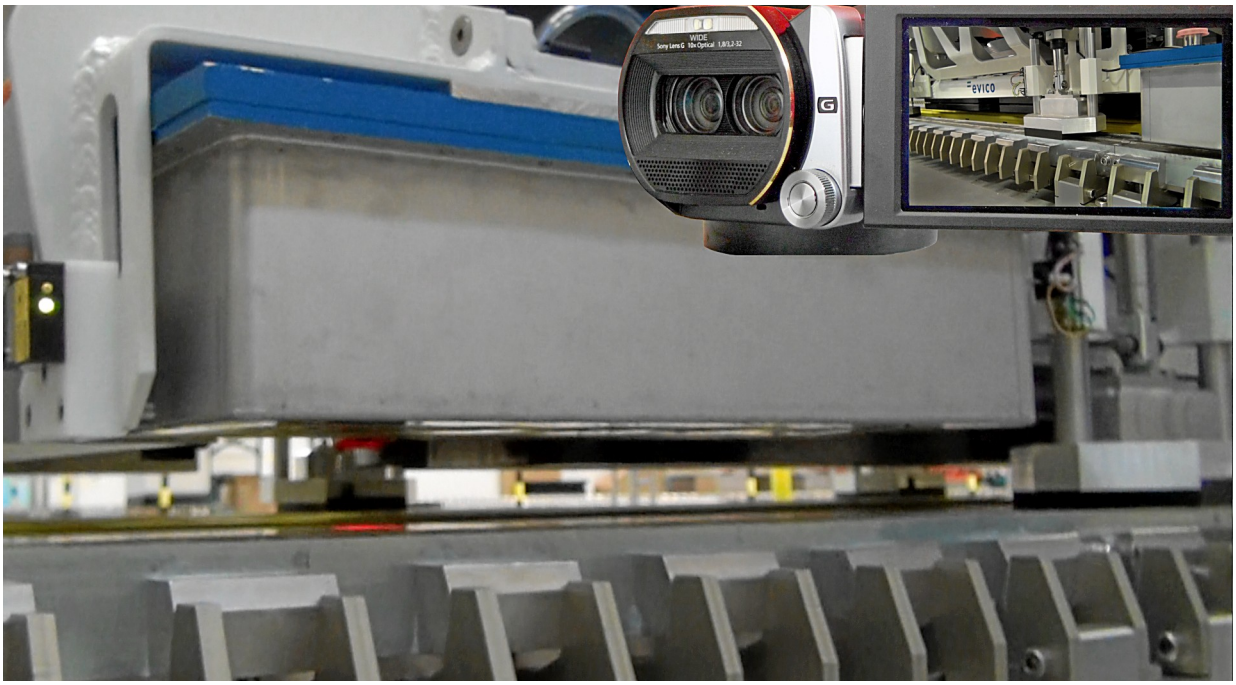

Fig. 3: Close shot of magnetic bearings with small stereo base (source: GFM-eV).

Most of the video scenes have been shot using a Sony HDR-TD10 camcorder with two objectives. For close shots, a Sony HDR-TD20 camcorder with a lower stereo basis (2 cm) was used (Fig. 2). This is a third of the distance between a human left eye and right eye and allows objects to be recorded within a distance range from 30 cm to 5 meters with a good 3D effect.

4. Go Green, Go Maglev!

“Go Green, Go Maglev!” was the slogan of the Maglev 2011 Conference at Daejon, South Korea.

This video shows some impressions of this conference and the following technical tour to the Korea Institute of Machinery and Materials (KIMM), where the conference visitors had the opportunity to take a ride on Korea’s Urban Maglev on a 1.3 km long test track.

The new maglev trainset to be demonstrated to the visitors is composed of two married-pair vehicles. It's “frontal shape is designed to imitate the shape of Korea’s traditional celadon porcelain” [11]. This prototype was tested in KIMM until 2013 [12]. The construction of the 6.1 km long demonstration line from Seoul to Incheon International Airport was finished at the end of 2012. Test operation and approval procedures were finished in 2014. The ridership in 2015 was expected to be 34,000 passengers per day. The demonstration line will be enhanced to an application line with a length of 57 km.

Another maglev line for Daejon is scheduled to go into operation starting 2019.

Fig. 4: On technical tour to 1.3 km long test track in KIMM (source: Prof. Wang, Chengdu, China).

Figure 4 shows the shooting at the guideway of the test track with the camera rig. Unlike the Transrapid guideway, no linear motor windings but rather an electrical power supply can be seen because the vehicle is driven by a short stator (motor inside).

5. Our goals

As pointed out in the first chapter, showing maglev systems in operation can help us to promote environmental awareness. The “Gesellschaft zur Förderung der Magnetschwebetechnologie (Transrapid) e.V.” (GFM-eV) was founded on June 9, 2000 as a non-profit organisation. Its target is to help to get rid of reservations against various maglev technologies and is inspired by the work of the former citizens’ action group “Pro Transrapid” at Perleberg (state of Brandenburg), which allowed us to use this name in our internet presence (www.pro-transrapid.org). Thanks to the educational work of this citizens’ action group, the planned Transrapid route Hamburg-Berlin found high acceptance: A petition for a referendum against the maglev which has been initiated by the Green Party, Socialist Party (PDS) and various environmental associations could officially be declared for Brandenburg to have been failed on March 3, 1998 because of missing majority approval of the voters. Among our members currently are resp. have been in the past engineers and politicians (even from Green Party).

By discussions with members of the Senate of Hamburg, we initiated a parliament's debate on January 18, 2006 at 9:33pm about a petition (senates paper "Drucksache 3472"). The petition claimed the construction of a Transrapid line with the integration of Hamburg and was accepted by a cross-party majority on that day. As a result, Hamburg started an initiative which was joined by the other states from the north of Germany to accomplish this line with support of the Federal Government. However, federal politicians denied it.

On June 14, 2007 we were invited to present our vision of an European Transrapid Network in the Directorate General for Transport and Energy (DG TREN). For our argumentation, videos were very helpful. For international applications, we produced an "independent" (i.e. not sponsored by the system industry) promotional video for maglev trains in four languages.

Fig. 5: A promotion video in German, Spanish, Turkish and English language (source: GFM-eV).

Figure 5 shows the different title scenes of the trailers. The languages were selected due to existing interest for a maglev line on the Isle of Tenerife (Spain), between Antalya and Alanya (Turkey) and last but not least in the UK and the USA. Parts of the Turkish version were published on the Turkish Wikipedia [13] with very small risk of removal by members of groups with conflicting interests.

Figure 6 shows the presentation of the Turkish video in the headquarters of Turkish Railways (TCDD) on May 14, 2010 to promote a Transrapid link in the tourist region between Antalya and Alanya. We were accompanied by a businessman named Lothar Albrecht, CEO of the FaG-ema electrical machinery craft business association, which had intended to perform electric installations along the projected Transrapid Hamburg-Berlin Link. He had developed a concept how to instruct Turkish workers to install linear motor windings and to use power supply by renewable energy for Transrapid in Turkey.

Fig. 6: Promotion of Transrapid in the TCDD headquarter Ankara, Turkey (source: GFM-eV).

When we started making Transrapid videos in 2004, TV broadcasting was still in standard definition, while in the USA and Japan HDTV had already been introduced. With the aid of a camcorder from the Japanese market, we could shoot our scenes from beginning in high definition video. Everyone who watched this first high definition video about the Transrapid at Lathen on a notebook with an appropriate display was impressed with the details in the pictures. The strategy was to combine the fascination with maglev technology with the fascination about high definition television by offering contents about an environment-friendly means of transport to anyone who was awaiting the launch of HDTV in Europe.

Making videos in 3D about maglev technology was the logical consequence of this. All videos are licensed by a Creative Commons License and are available over the internet in an open manner. This means that they use a patent-free audio and codec (VP8) and are packed into a WEBM container. Thus, they are downloadable from the internet without the risk to pay software patent license fees, which would not be the case if they would use MP4 codecs. Furthermore, the WEBM container format is supported by open source software like the VLC Media Player or Bino 3D Player and also the Firefox browser and enables platform-independent usage (i.e. the videos can be played under Linux, OS X, Android, iOS and Microsoft Windows). The WEBM container was filled with special metadata like title, author description and license information. A small file patching program was developed to do this (the reasons can be found in [14]).

In spite of this, we still did not reach our goals in Germany because the political hurdles had been increasing. Nevertheless, time is working in favor of the technology. It should kept in mind until better days by means of the Transrapid 3D video against the oblivion.

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Summary

The presentation of maglev videos in 3D provide an example how environmental awareness can be promoted with transport systems which enable sustainable non-intrusive traffic by a reduction of environmental impact and waste of mineral deposits by the renewal of worn out materials. From the beginning, maglev videos were produced using new production technologies. Next demonstrations should be made as 360 degree productions, and for best effects, in 3D as interactive learning game.

References

[1] Sandrew, Barry (2013): The Power of Social Networks, 3D Documentaries and 3D Feature Films to Promote Environmental Intelligence Retrieved 07 16, 2016, from bsandrew.blogspot.de: http://bsandrew.blogspot.de/2013/06/invited-presentation-to-world-cultural.html, June 1, 2013

[2] Gunst, Christian (2013): 3D zum Anfassen *[means: 3D as you can touch]*, p. 61 – 104. Master Thesis, Pädagogische Hochschule Heidelberg, Germany *(in German)*.

[3] Tum, Michael / Huhn, Gregor / Harbeke, Christian (2006): Design and Development of the Transrapid TR09. International Maglev Conference 2006, Dresden, Germany

[4] Metzner, Jörg (2006): The Transrapid Testfacility (TVE) – Practical testing for success in commercial operation. International Maglev Conference 2006, Dresden, Germany

[5] Henning, Uwe / Hooke, Dirk / Nothhaft, Jürgen (2004): Development and Operation Results of Transrapid Propulsion System. International Maglev Conference 2004, Shanghai, China

[6] Intis (2014): Presenting a test centre for electric vehicle inductive energy transfer systems. EcarTec 2014 Fair, Munich, Germany Retrieved 07 23, 2016, from intis.de: http://www.intis.de/assets/ecartec2014_e.pdf

[7] IHS Hybrid-EV (2015): EVs Unplugged [Interview of Richard Gould]. IHS Automotive Hybrid-EV Analysis Vol 6 Issue 5, p. 8 – 11 Retrieved 07 23, 2016, from intis.de: http://www.intis.de/assets/intis---hybrid-ev-analysis---volume-6-issue-5.pdf

[8] Transport Research Laboratory (2015): Feasibility study: Powering electric vehicles on England's major roads. Retrieved 07 23, 2016, from highways.gov.uk: http://assets.highways.gov.uk/specialist-information/knowledge-compendium/2014-2015/Feasibility+study+Powering+electric+vehicles+on+Englands+major+roads.pdf

[9] Kühn, Lars / de Haas, Oliver / Berger, Dietmar / Schultz, Ludwig / Olsen, Henning / Röhlig, Steffen (2012): SupraTrans II – Fahrversuchsanlage für eine Magnetbahn mit Supraleitern *[means: SupraTrans II – test facility for a magnetic train with supraconductors]*. Elektrische Bahnen, 110, 461-469, 8-9 2012 *(in German)*.

[10] Kühn, Lars / de Haas, Oliver (2014): LN2-free Superconducting Magnetic Bearings continuous cooled by cryocoolers for industrial applications and urban transportation systems. International Maglev Conference 2014, Rio de Janeiro, Brazil

[11] Shin, B. C. / Kim, W. J. / Park, D. Y. / Baik, S. H. / Beak, J. G. / Kang, H. S. (2014): Recent Progress of Urban Maglev Program in Korea. International Maglev Conference 2011, Daejon, South Korea

[12] Shin, B. C. / Park, D. Y. / Han, H. S. / Lee, J. M. / Baik, S. H. / Beak, J. G. / Kang, H. S. (2014): Korea's First Urban Maglev System. International Maglev Conference 2014, Rio de Janeiro, Brazil

[13] GFM-eV (2010): Manyetik Hızlı Tren - Geleceğin Seyahatini bu günden başlatıyoruz Retrieved 07 23, 2016, from tr.wikipedia.org: https://tr.wikipedia.org/wiki/Manyetik_rayl%C4%B1_tren

[14] Project WEBM issues (2015): issue 1077 vpxenc encoding parameter should support writing some global metadata into webm file Retrieved 08 04, 2016, from bugs.chromium.org: https://bugs.chromium.org/p/webm/issues/detail?id=1077#c1

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