NURail Center

National University Rail Center

Annual Report

2012

University of Illinois at Urbana-Champaign
University of Illinois at Chicago
Massachusetts Institute of Technology
Michigan Technological University
University of Kentucky
University of Tennessee, Knoxville
Rose-Hulman Institute of Technology

Rail Focused US DOT–RITA Tier I University Transportation Center

Contents

This publication is a report of the NURail Center's transportation research, education and workforce development, and technology transfer activities for January 1, 2012 – December 31, 2012.

National University Rail Center
University of Illinois at Urbana-Champaign
1239B Newmark Engineering Laboratory, MC-250
205 N. Mathews Ave.
Urbana, IL 61801
217-244-4999 (phone)
217-333-1924 (fax)
NURail-Center@illinois.edu

For updates and more information visit: www.nurailcenter.org

Program Coordinator: LB Frye
Designer: Nizam Uddin Ahmed
The entire NURail team contributed to the content of this report.
Photographs by NURail faculty, staff or students, unless otherwise noted.

NURail Center

The National University Rail (NURail) Center is a Tier-1 University Transportation Center (UTC) focused on rail transportation and funded by the U.S. Department of Transportation (US DOT) – Research and Innovative Technology Administration (RITA) UTC program. The NURail Center is a seven-university consortium led by the Rail Transportation and Engineering Center (RailTEC) at the University of Illinois at Urbana-Champaign (UIUC) and hosted by the Department of Civil and Environmental Engineering at UIUC.

U.S. Department of Transportation
Research and Innovative Technology Administration

Christopher Barkan
Center Director

Conrad Ruppert, Jr.
Associate Director for Research

Pasi Lautala
Associate Director for Education and Workforce Development

Rapik Saat
Assistant Director for Research

C. Tyler Dick
Assistant Director for Education and Workforce Development

Timothy Gress
Managing Director

Director's Message

The U.S. freight railroad system is one of the transportation success stories of the latter 20th and early 21st centuries. The efficiency of North American freight rail transport is a world leader, providing the nation with substantial economic, energy, and environmental benefits. Meanwhile, increasingly congested highway and air transport systems, concerns about energy scarcity and cost, and the need for environmentally sustainable personal mobility and urban livability have all favored investment in modern, efficient urban, regional and high-speed intercity passenger rail systems.

For all these reasons, both freight and passenger rail have been experiencing a renaissance over the past several decades with major private and public sector investments in new infrastructure, rolling stock and advanced technologies. Effectively planning, designing, building and operating these new rail transportation systems requires a unique combination of skills and knowledge. But, while rail transport has been on the ascendency, the academic programs needed to engage faculty and educate students in the principles of railway transport, engineering and planning have nearly disappeared.

NURail Center co-PIs held their first planning meeting during TRB's Summerail meeting hosted by the Indiana Rail Road in July 2011. They are shown here with their students and rail industry professionals who attended.

The importance of transportation education and research is well recognized and has been supported by the US DOT - RITA UTC Program. This program - celebrating its 25th anniversary this year - has helped the U.S. develop world-class academic transportation expertise among university faculty and helped educate thousands of students who have entered the workforce, primarily in highway and air transportation. But efficient and effective transportation systems must take advantage of the best attributes of all modes, both operating alone, and as part of an integrated, multi-modal whole. RITA recognized this when they reorganized the UTC Program in 2011 and their solicitation for proposals called for a balanced, multimodal approach.

The NURail principal investigators (PI) at the partner institutions are united in their belief that rail is a vital element of a balanced transportation system. These faculty, from a small, diverse group of colleges and universities around the nation, began working together in the mid-2000s, first supporting one another's development of rail programs and then, reaching out to faculty at other colleges and universities to support their efforts to expand or reintroduce rail into research and educational programs at their schools. When RITA announced the UTC reorganization, these faculty immediately recognized the opportunity and formed the consortium that developed what proved to be a successful proposal for the first-ever, rail-focused UTC in the program's history, the National University Rail (NURail) Center.

Understanding and improving rail transportation requires a multi-disciplinary approach; the NURail consortium appropriately reflects this. All of the major branches of engineering are involved along with significant planning and policy expertise. Furthermore, the NURail PIs have substantial experience with the rail industry or public sector rail organizations. This is critically important because, while understanding what is technically possible is necessary, it is not sufficient in developing an effective program of transportation research and education. Faculty and their students must understand the context and institutional constraints in which their results will be applied if their work is to have an impact. Furthermore, as mentioned above, rail functions most effectively as part of an integrated multi-modal system. The NURail PIs have experience with other modes and an appreciation and interest in rail's interactions and inter-relationships with them.

This report describes the launch of the NURail Center and its accomplishments in its first year. The members of the consortium appreciate the opportunity that US DOT/RITA has given us and we are mindful of the special responsibilities this implies. We are hopeful that this Annual Report will be the first of many in years to come, as the NURail Center strives to support the nation's rail and transportation communities.

Sincerely,

Chris Barkan

University of Illinois at Urbana-Champaign

The University of Illinois at Urbana-Champaign (UIUC) is a leader in railway engineering research and education in North America, with a rich history of significant contributions dating back over a century. UIUC has a distinguished record of accomplishment and remains highly respected by today's railway engineering community. UIUC has substantially expanded its Rail Transportation and Engineering Center (RailTEC) through research and educational programs during the past 15 years. UIUC has been an AAR Affiliated Lab for over 30 years. In this role they work with the railroad industry conducting research on new and emerging technologies to improve rail transportation safety, efficiency and reliability.

UIUC is also committed to and actively engaged in supporting development of other academic rail transportation and engineering programs in the United States and abroad. UIUC's long and distinguished leadership in railroad transportation reflects a deep institutional knowledge and understanding of the field, including expertise in traditional rail disciplines as well as emerging research areas critical to safe, efficient, reliable and economical passenger and freight rail transport.

University of Illinois at Chicago

The University of Illinois at Chicago (UIC) is a leader in railway mechanical engineering, transportation planning and transit. UIC has strong collaborative relationships with all the major freight and passenger railroads in the Midwest. The Urban Transportation Center at UIC is a research center affiliated with the Department of Urban Planning and Policy's Master's and Ph.D. program and the specialization in urban transportation. A variety of departments throughout the university offer transportation courses, many of which involve a rail component. Courses like Principles of Computational Transportation Science, Advanced Transportation Demand Analysis, and Railroad Vehicle Dynamics in the College of Engineering, complemented by Funding and Finance of Transportation Projects and Economic Analysis of Public Expenditures, showcase the diverse research and education opportunities at UIC.

Due to the importance of rail in the state, the Illinois Department of Transportation (IDOT) has an extensive rail program supporting freight, intercity passenger and urban rail transport, including extensive research at both UIUC and UIC. In a recent collaboration with IDOT, UIUC and UIC completed a preliminary feasibility study for a high speed rail (HSR) system connecting Chicago, Champaign, St. Louis and Indianapolis.

Massachusetts Institute of Technology

The Massachusetts Institute of Technology (MIT) contributes to the development of solutions for regional and national transportation problems, including a long legacy of important rail contributions. Under the leadership of Professor Joseph Sussman, the Regional Transportation Planning and High-Speed Rail Research Group (http://web.mit.edu/hsr-group/index.html) is conducting path-breaking work directly related to NURail Center goals. Professor Sussman is the JR East Professor (endowed by the East Japan Railway Company) at MIT and through that relationship has made important contributions in HSR safety, protection from natural hazards and transportation reliability.

MIT's public transportation program is highly respected, educating numerous students each year. Urban rail transportation is an area in which they make major contributions in the U.S. and abroad (e.g. Transport for London and HSR in the UK). Through its Center for Transportation and Logistics (CTL) founded in 1973, MIT has performed path-breaking research in the rail freight sector in areas including service reliability, productivity, wheel-rail dynamics, investment and maintenance planning, and freight car utilization. In recent years, the Transportation@MIT initiative (http://transportation.mit.edu) has expanded transportation-related activities into many departments and centers at MIT.

Michigan Technological University

The Rail Transportation Program (RTP) at Michigan Technological University (Michigan Tech) has developed under Director Pasi Lautala's leadership into a one of the leading rail education and research programs in the U.S. Established in 2007 within the Michigan Tech Transportation Institute (MTTI), the program places a high priority on rail transportation and engineering related education. Continued educational development areas include a Rail/Transportation Engineering Certificate, expansion of industry-funded undergraduate Senior Design and Enterprise rail projects, as well as increasing numbers of summer internships. NURail Center research collaborations with rail industry stakeholders focus on rural freight rail and multimodal transportation improvements, human factors and rail safety, infrastructure evaluation and assessment, high performance materials for railroad infrastructure preservation, and renewal and improved materials for rail industry. The RTP provides the foundation for all rail related activities in the field and has become a permanent part of university curriculum and research at Michigan Tech.

University of Kentucky

The State of Kentucky was a leader in the development of the rail system in the United States, having one of the first operative railroads in 1831. Its rail system played an important role in the development and sustainability of the state's coal industry since the very early 1900s. Several of this nation's major north-south heavy traffic rail lines -- CSX, NS, and CN – pass through Kentucky. These comprise the bulk of Kentucky's over 2,500 miles of track which is augmented with local collector lines mainly operated by smaller rail companies.

The Civil Engineering Department at the University of Kentucky (UK) was an early leader among universities in the re-establishment of an academic emphasis in railway transportation beginning in the early 1980s. The rail-related research program is a major component of UK's railway emphasis. Numerous research projects have been conducted during the past thirty years. These are funded by a combination of railroad companies, governmental agencies, and individuals. Over fifty graduate and undergraduate students have participated in these studies.

University of Tennessee, Knoxville

The University of Tennessee, Knoxville (UTK) has been a national leader in transportation research and education for over 50 years. Students with particular interests in rail transportation are welcomed in the UT Rail Society, which is also an AREMA student chapter.

NURail Center activities are coordinated by the UTK Center for Transportation Research (CTR). One of the oldest dedicated academic centers focusing on transport, CTR celebrated its 40th anniversary in 2012. CTR has a long tradition of excellence in rail transportation research and education, with particular strengths in economics, planning, safety, and workforce development. CTR has been a provider of education and training to the railroad industry for over 25 years. Current courses address railroad track and structures design, safety inspection, and maintenance. CTR has strong relationships with the railroad and planning offices at the Tennessee Department of Transportation, with Class 1 and shortline railroads operating in the southeast, with railroad contractors and suppliers, and with the Oak Ridge National Laboratory. CTR hosts the 2013 Joint Rail Conference.

Rose-Hulman Institute of Technology

Rose-Hulman Institute of Technology (Rose-Hulman) is home to 2,100 undergraduate and 100 graduate students majoring in engineering, science or mathematics with a mission to provide students with the world's best undergraduate science, engineering, and mathematics education in an environment of individual attention and support. With a 1:13 faculty-student ratio, faculty can take a personal interest in each student's success at Rose-Hulman. Students prepare for their careers through hands-on education where they learn the value of teamwork as well as formulas and equations. Rose-Hulman is ranked No. 1 in its category by U.S. News & World Report. Among individual engineering programs, Rose-Hulman ranked No. 1 in five areas: chemical engineering, civil engineering, computer engineering, electrical engineering and mechanical engineering.

Organization Chart and Advisory Members

Executive Advisory Board

Robert C. VanderClute
Association of American Railroads

Michael W. Franke
Amtrak

Michael P. Melaniphy
American Public Transportation Association

Gregory C. Fox
BNSF Railway Company

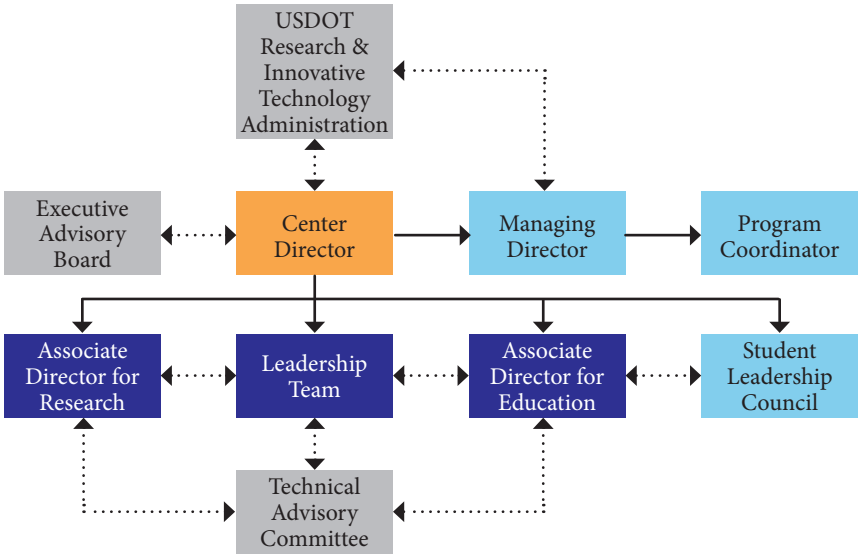
David W. Ferryman, P.E.
Canadian National Railway Company

John Tunna
Federal Railroad Administration

Ann L. Schneider
Illinois Department of Transportation

Thomas D. Simpson
Railway Supply Institute

NURail Center Organization Chart



NURail Center 2012 New Faces

Conrad Ruppert Jr. joined RailTEC in May 2012 as a Senior Research Engineer and to serve as the NURail Center's Associate Director for Research. Mr. Ruppert holds a Bachelor of Science degree in civil engineering from Princeton University (1977) and a Master of Science degree in technology management from the University of Pennsylvania (1999).

Over the course of his 35-year career with Amtrak on the Northeast Corridor, he held positions covering most aspects of railway track engineering, maintenance operations and track research. He will use this experience to direct research programs and help mentor civil engineering students who are interested in pursuing careers in railroad engineering. He is co-teaching a new course in rail vehicle dynamics for the Spring 2013 semester and will develop the curriculum for and ultimately teach a course on advanced railway track engineering theory and design.

Mr. Ruppert's research interests include improving the performance of railroad infrastructure, optimizing railroad maintenance operations and advancing the use of asset management systems.

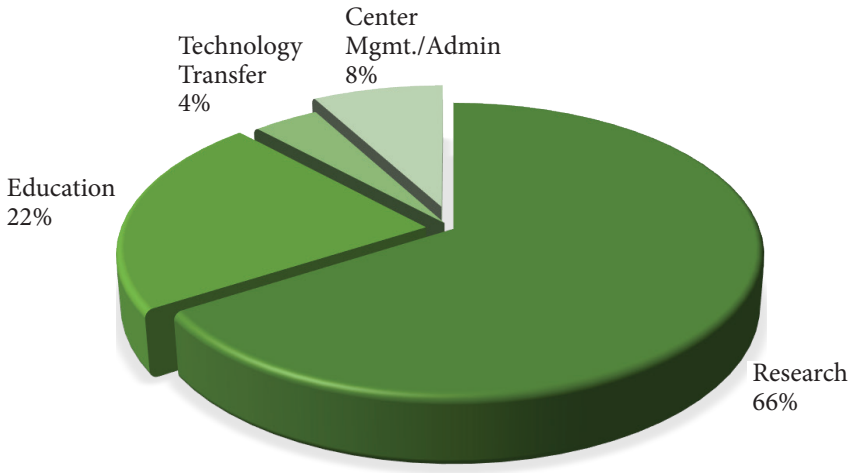
C. Tyler Dick, P.E. joined RailTEC in June 2012 as a Senior Research Engineer and to serve as NURail Assistant Director for Education. Mr. Dick holds a Bachelor of Science degree in civil engineering from the University of Manitoba (1999) and a Master of Science degree in civil engineering from the railroad engineering program at the University of Illinois at Urbana-Champaign (2001).

Mr. Dick spent 11 years as a railway track design engineer with HDR Engineering in Dallas/Ft. Worth, TX where he specialized in route and relocation studies; rail operations simulation; and rail design of mainline alignments, industrial tracks, highway grade separations, hump classification yards and intermodal facilities. Dick brings his extensive rail design experience to the classroom while co-teaching a course on railway project planning and will develop the curriculum for and ultimately teach a course on railway operations and terminal design.

Mr. Dick's research interests focus on railway operations and efficiency; line capacity and network planning; and yard and terminal design.

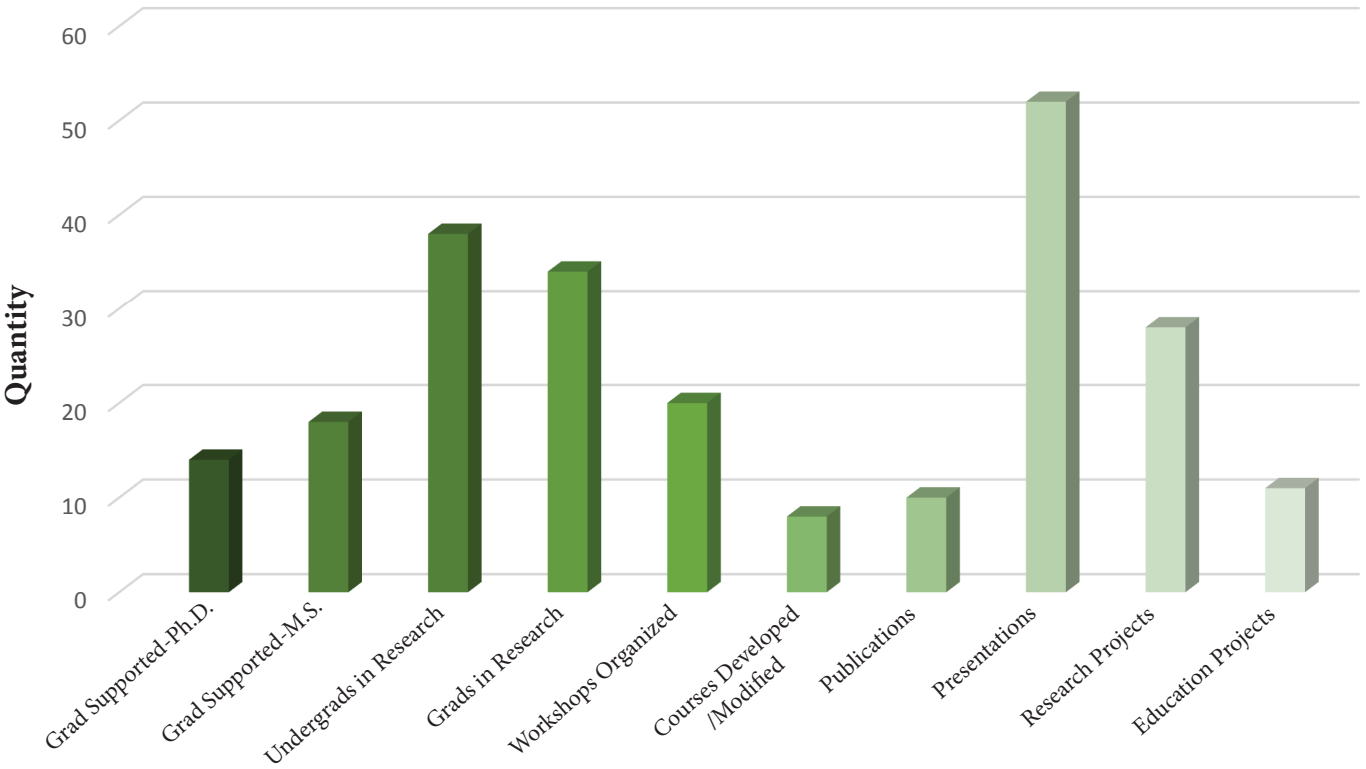
NURail Center by the Numbers

Year 1 Funds Distribution



The total funding for NURail Center activities in Year 1 was 66% for research, 22% for education, 4% for technology transfer, and 8% for center management and administration and is shown in the figure above.

Year 1 Accomplishments



This figure displays a graphical representation of some of the NURail Center's accomplishments.

2012 Timeline

NURail Center

JANUARY

January 17, 2012 - The US DOT awarded a $3.5 million grant to a seven university consortium creating the National University Rail Center.

January 31 – February 3, 2012 – Queretaro and Monterrey, Mexico were the locations of the first three railroad track inspection classes taught by NURail consortium partner, David Clarke from UTK.

Spring 2012 - A newly developed graduate course on shared rail corridor engineering and transportation was taught to 18 UIUC graduate students. The class focused on identifying and understanding the most critical infrastructure, rolling stock, traffic control, operations, line capacity and institutional constraints affecting the combination of heavy-axle-load freight and higher-speed rail passenger operations.

Students discuss technical challenges in the new CEE 598 Shared Rail Corridor course during the Spring 2012 semester at UIUC

APRIL

April 24 – 26, 2012 – Chris Barkan and Pasi Lautala participated in the CUTC National Workforce Summit at the L'Enfant Plaza Hotel in Washington, D.C. Lautala presented in a workshop related to the rail industry workforce development.

April 26, 2012 - UIUC faculty, staff, and students organized and hosted 30 grade school and high school students for a minisymposium on railway transportation engineering.

MAY

U.S. Department of Transportation
Research and Innovative Technology Administration

May 16 - 17, 2012 – The NURail Center Kick-off Meeting was held at the University of Illinois at Urbana – Champaign.

NURail Center Kick-off Meeting attendees

JUNE

June 6 – 8, 2012 – The International Concrete Crosstie and Fastening System Symposium was conducted featuring over 30 presentations on design and performance challenges and solutions for concrete ties and fastening systems.

June 11 – 13, 2012 - The NURail Center partnered with the American Railway Engineering and Maintenance of Way Association (AREMA) to organize the 2012 Railway Engineering Education Symposium (REES). REES 2012 provided engineering professors with railroad education materials to assist them in expanding their curriculum to include greater breadth and depth in rail transportation engineering.

Attendees of REES 2012

June 30, 2012 – To date, 16 research and seven education proposals for NURail Center funding were under review, and an additional eight research and five education proposals had been received.

July 8 – 14, 2012 - The third annual Rail and Intermodal Transportation Summer Youth Program was conducted for high school students at Michigan Tech in collaboration with the University of Wisconsin-Superior. Ten high school students from around the nation spent one week in hands-on transportation related learning modules as well as field visits to rail and intermodal sites.

Attendees of the Summer Youth Program

July 9, 2012 - A one day workshop was held in Philadelphia focusing on the development of a cooperative rail research and education program with KTH (Swedish Royal Institute of Technology).

September 16 – 19, 2012 – Over a dozen NURail faculty and students attended the AREMA conference and participated at the exhibit hall.

Conrad Ruppert, Jr. (second from left) is joined by students Sam Sogin, Sam Chadwick and Laura Ghosh (left to right).

September 16, 2012 - The NURail Center conducted a collaborative workshop to implement the Strategic Development Plan in the area of Rail Vehicle/Track Interaction and Dynamics at the Electronic Visualization Laboratory in the UIC College of Engineering.

September 19 – 21, 2012 – NURail partner David Clarke taught a track design class in Olympia, WA.

November 8, 2012 – "Rehabilitation Techniques to Improve Long-Term Performances of Highway-Railway At-Grade Crossings" was presented at the 2012 Southeastern Rail Highway Safety Conference in Charlotte, NC by Jerry Rose.

JULY **SEPTEMBER** **OCTOBER** **NOVEMBER** **DECEMBER**

Fall 2012 - UIUC hosted five on-campus Hay Seminar Series speakers from railway industry experts that were also broadcast online.

Fall 2012 - NURail Center faculty, staff, and students were part of a team conducting 220 MPH HSR Feasibility Study for IDOT. The project addressed a proposed 220 MPH HSR corridor from Chicago-O'Hare International Airport to Champaign, IL with connecting links to St. Louis, MO and Indianapolis, IN.

Fall 2012 – Faculty at both UK and UIUC used NURail Center funding for curriculum design. UK redesigned the CE433 Railroad Operations course while UIUC developed a new HSR systems course.

October 15 – 16, 2012 - The 2012 Railroad Environmental Conference (RREC) was hosted at UIUC where more than 400 attendees exchanged views, learned about new techniques and technologies, and were updated on the direction of the railroad industry's environmental programs.

Michael Avans, Lanny A. Schmid, Robert Fronczak, Ken A. Roberge and Edward P. Phillips at RREC. (From left).

December 3, 2012 - The NURail Center student team from MIT participated in an outreach meeting in Boston focusing on the Northeast Corridor research work and making useful contributions to the discussions.

December 4, 2012 - Reg Souleyrette presented at an NTSB GIS for Transportation Safety Conference that included information about the rail crossing 3D sensor being developed by UK through NURail Center funding .

Honorable Mark R. Rosekind, PhD, Honorable Deborah A. P. Hersman, Honorable Robert L. Sumwalt, Reg Souleyrette, and Stephen Lewis (From left).

Leaders

Christopher P.L. Barkan
NURail Center Director
Professor, George Krambles Faculty Fellow
Director of Rail Transportation and Engineering Center
University of Illinois at Urbana-Champaign
1245 Newmark Civil Engineering Laboratory, MC-250
205 N. Mathews Ave, Urbana, IL 61801
Ph: 217-244-6338 cbarkan@illinois.edu

Christopher P. L. Barkan is Professor, Executive Director of RailTEC, and the George Krambles Faculty Fellow in the Department of Civil and Environmental Engineering at UIUC where he has been on the faculty for over 15 years. As Director of RailTEC he is responsible for railroad engineering research and academic activities at UIUC and supports research on a wide range of topics to improve rail safety, reliability and efficiency. Prior to joining UIUC he directed the railroad industry's risk engineering research in the AAR's Research & Test and Safety & Operations Departments. He has been actively involved in positions of leadership at the Transportation Research Board (TRB) and the American Society of Civil Engineers (ASCE). Professor Barkan is the author or editor of more than 100 railroad-engineering papers, reports, chapters or books on a range of topics. He has been an invited or keynote speaker at conferences, universities and corporations around the globe.

Ahmed A. Shabana
Richard and Loan Hill Professor of Engineering
Director of the Dynamic Simulation Laboratory (DSL)
University of Illinois at Chicago
842 West Taylor Street, Chicago, IL 60607
Ph: 312-996-3600 shabana@uic.edu

Ahmed A. Shabana is a University Distinguished Professor and the Richard and Loan Hill Professor of Engineering at UIC. He is an internationally recognized leader in the field of computational mechanics and nonlinear multibody dynamics, including rail applications. Professor Shabana's railroad research developing algorithms for railroad vehicle and track dynamics has been funded by the FRA since 1999 and he has developed computer programs that are licensed to industry and federal agencies. He is the author of Railroad Vehicle Dynamics: A Computational Approach and four other books. He has published 192 refereed journal articles (27 in rail) and 238 conference papers and technical reports (57 in rail), supervised 38 Ph.D. students (8 in rail) and 44 M.S. students (9 in rail). He is the Founding Chair of the American Society of Mechanical Engineers (ASME) Technical Committee on Multibody Systems and Nonlinear Dynamics and is Editor-in-Chief of the ASME Journal of Computational and Nonlinear Dynamics; he also serves as associate editor or editorial board member for 11 other journals.

Pasi T. Lautala
Assistant Professor
Department of Civil and Environmental Engineering
Director, Rail Transportation Program
Michigan Tech Transportation Institute (MTTI)
Michigan Technological University
1400 Townsend Drive, Houghton, MI 49931
Ph: 906-487-3547 ptlautal@mtu.edu

Pasi T. Lautala is Assistant Professor and Director of the Rail Transportation Program at Michigan Tech. He is the Associate Director for Education of the NURail Center. Professor Lautala is a national leader in re-establishing rail transportation education in North American universities, and has developed several courses at Michigan Tech on railroad topics. He was co-PI on an international cooperative project studying rail educational activities in the United States and Europe (TUNRail) and is actively involved in international rail educational initiatives. Prior to his academic appointment, he was employed in railroad planning, design, and operations in the United States and Finland, and is a member of several professional associations including AREMA, ASCE, ASEE and TRB.

Joseph M. Sussman is the JR East (East Japan Railway Company) Professor in the Department of Civil and Environmental Engineering and the Engineering Systems Division at MIT. He has served as an MIT faculty member for 45 years. He is the author of Introduction to Transportation Systems, a graduate text in use at a number of universities, and Perspectives on Intelligent Transportation Systems. He received the Roy W. Crum Distinguished Service Award from TRB, its highest honor, "for significant contributions to research" in 2001, and the Council of University Transportation Center (CUTC) Award for Distinguished Contribution to University Transportation Education and Research in 2003. In 2002 Intelligent Transportation System (ITS) Massachusetts named its annual "Joseph M. Sussman Leadership Award" in his honor. Professor Sussman's research in railroads has had a major impact on the industry in the U.S. and abroad with several prize-winning papers.

Joseph M. Sussman
JR East Professor
Professor of Civil and Environmental Engineering and Engineering Systems
Massachusetts Institute of Technology
77 Massachusetts Ave.
Room 1-163 Cambridge, MA 02139-4307
Ph: 617-253-4430 sussman@mit.edu

Stephen E. Schlickman is Executive Director of the Urban Transportation Center at UIC. He has served as adjunct faculty in the Urban Planning and Policy Department since 1999, teaching graduate courses in the funding and finance of transportation projects. He served as Executive Director of the Regional Transportation Authority from 2005-2010 where he was responsible for overseeing, planning and coordinating the region's transit operating agencies. He manages his own consulting practice providing financial, project policy and legislative advice to clients involved in all modes of surface transport, and managing the team designing a new transit system for downtown Chicago. He is a member of the Illinois Public Transportation Association, serving as its president in 1989; on the legislation committee for the American Public Transit Association (APTA); on the board for the Chicago Metropolitan Agency for Planning; and founding chairman of the New Starts Working Group, a national coalition of major transit projects.

Stephen E. Schlickman
Executive Director of the Urban Transportation Center
College of Urban Planning and Public Affairs
University of Illinois at Chicago
412 S. Peoria, Suite 340, Chicago, IL 60607
Ph: 312-355-3656 sschlick@uic.edu

David B. Clarke is Executive Director of the UTK Center for Transportation Research and Research Associate Professor in the Department of Civil and Environmental Engineering. Professor Clarke has served as a university faculty member, consulting engineer, research manager, and researcher. His transportation experience includes a variety of projects in the areas of planning, design, system operations, and research. He is active in national efforts to promote railway research and education, and teaches classes and short courses on rail subjects. He is active in AREMA, ASCE and TRB. He is Chairman of the ASCE Rail Transportation Committee, is an Emeritus Member and former Chair of the TRB Freight Rail Committee and is Chairman of the 2013 Joint Rail Conference, the principal North American rail research conference.

David B. Clarke
Research Associate Professor
Department of Civil and Environmental Engineering
Director of the Center for Transportation Research
University of Tennessee, Knoxville
309 Conference Center Building
Knoxville, TN 37996-4133
Ph: 865-974-1812 dclarke@utk.edu

Leaders

James L. McKinney
Roland Hutchins Distinguished Professor
of Civil Engineering
Rose-Hulman Institute of Technology
5500 Wabash Ave., Olin-217
Terre Haute, IN 47803
Ph: 812-877-8335
james.mckinney@rose-hulman.edu

James L. McKinney is Emeritus Professor of Civil Engineering at Rose-Hulman. Prior to his retirement in 2012, Professor McKinney was the R. C. Hutchins Distinguished Professor of Civil Engineering. He also served as Chairman of the Civil Engineering Department from 1982-2000 and 2005-2006. He is currently developing an interdisciplinary Railroad Engineering course as part of the NURail Center. He is also the founding faculty advisor for the Rose-Hulman AREMA Student Chapter. His teaching areas included surveying, construction engineering, cost engineering, engineering economics, civil engineering materials, and transportation engineering. He is a Life Member of the American Society of Engineers, serving as the Indiana Section President 1987-1988. He is the Hot Mix Asphalt Quality Assurance Program Coordinator for the Indiana DOT and the Asphalt Pavement Association of Indiana.

Reginald R. Souleyrette
Commonwealth Chair
Professor of Transportation Engineering
Department of Civil Engineering
College of Engineering, University of Kentucky
259 Raymond Civil Engineering Building
Lexington, KY 40506
Ph: 859-257-5309 souley@engr.uky.edu

Reginald R. Souleyrette is Commonwealth Professor of Civil Engineering at UK, where he also serves as a program manager for the Kentucky Transportation Center. He joined UK in 2011 following 18 years at Iowa State University. Professor Souleyrette conducts research on safety information systems, GIS, railroad engineering and remote sensing. He is the immediate past chair of Transportation Research Board's Data and Information Systems section. He is a member of AREMA, ASCE, and TRB and a fellow of the Association of Traffic Safety Information Systems Professionals. Professor Souleyrette is registered as Professional Engineer in Iowa and Kentucky.

Jerry G. Rose
Professor of Civil Engineering
Department of Civil Engineering
University of Kentucky
261 Raymond Civil Engineering Building
Lexington, KY 40506
Ph: (859) 257-4278 jerry.rose@uky.edu

Jerry G. Rose is a professor in the Department of Civil Engineering at UK since 1971 in the areas of Materials, Transportation and Construction. He is a native Kentuckian and a civil engineering graduate of UK and Texas A&M University. He is a registered PE and a member of several technical societies, including the ASCE and AREMA. In addition to teaching at the university, Professor Rose has been the Principal or Co-Principal Investigator on 23 research projects culminating in 134 technical publications and 97 technical presentations to conferences. During recent years he has been extensively involved with the Railway Engineering aspects of the transportation related curriculum and research program in civil engineering at UK. The UK program has served as a precursor to the recent establishment and resurgence of Railway Engineering programs at other universities in the US. Some 35 graduate students during the past 12 years have performed the research component of their graduate requirements in the area of Railway Engineering under his guidance.

University of Illinois at Urbana - Champaign

The Thalys high-speed rail service between Amsterdam, Netherlands and Brussels, Belgium.

Project: Development of HSR Curriculum

HSR transportation systems are in operation or under development in dozens of countries throughout the world. The development of HSR in the U.S. requires engineers and planners to understand all aspects of the HSR system. This includes planning, engineering, construction, operations, maintenance, and system management. To support the goal of advancing railroad transportation education in the U.S., UIUC offers a comprehensive HSR curriculum consisting of semester-long courses in HSR engineering, planning and construction management. The courses are offered on the UIUC campus and online with an average class size of 35 students on-campus and 5-10 students online; a total of 150 students have taken these three courses since they were first offered in 2011.

An additional course in HSR operations and maintenance is under development, supported in part by the NURail Center, and will be offered in 2014. This project is led by T.C. Kao, Visiting Scholar and NURail Center Associate Director of International Programs. Prior to arriving at UIUC, Professor Kao was the Vice President with Taiwan High-Speed Rail and has 24 years of experience in the planning, design, construction, commissioning and operation of HSR systems.

Project: Accident Analysis of Passenger Trains on Freight Rail Corridors

Among the many challenges facing further expansion of passenger service on freight rail corridors is a better understanding of the safety implications of operating freight and passenger trains in the shared corridor environment. Quantitative understanding of train accidents on shared passenger and freight rail corridors is critical for rational allocation of resources to reduce the risk of train accidents. Train accident data from the Federal Railroad Administration database were analyzed to examine the effects of different accident causes on both passenger and freight trains. Preliminary findings indicate that the majority of passenger trains accidents result from a set of human factors causes while freight train accidents are primarily due to broken rails, other infrastructure defects and rolling stock mechanical causes. It is hypothesized that these different causes are a result of different operating practices, equipment inspection frequencies and maintenance standards; and axle loads and suspension characteristics. The differing sets of accident causes suggest that lines with varying traffic mixtures will require distinct approaches to mitigating the risk of train accidents. Current research is investigating the phenomena of adjacent track derailments where an incident on one track results in a collision on a parallel track. Such derailments may pose a risk even in situations where passenger and freight trains operate on separate dedicated tracks in the same right-of-way.

Samantha Chadwick

Originally from Shrewsbury, MA, Samantha Chadwick earned a Bachelor of Science degree in Civil Engineering at UIUC in December 2010. She is currently completing her Master of Science degree and thesis research at UIUC which focuses on understanding the effect of grade crossings on train safety and risk. The objectives of her research include identifying and understanding the physical factors leading to derailments at grade crossings, evaluating the risk, and prioritizing decisions to upgrade or close grade crossings. She has presented her research at conferences and published her work in a peer-reviewed journal.

Samantha is past president of the AREMA Student Chapter at UIUC where she participated in outreach activities designed to educate students about possible careers in railway engineering and mentored engineering students through their curriculum. This effort reached students at four different universities and increased awareness of the benefits of railroad transportation. She recently was selected among 18 young scholars nationwide to be named a Luce Scholar. This highly-competitive program provides full stipends and internships for recipients to live and work in Asia to increase Asian awareness among future leaders in American society. Samantha's assignment will be in Taiwan. After completing her work abroad she plans to "lead the charge towards HSR in America" and further unlock transportation developments in commuter rail and subway networks in the United States.

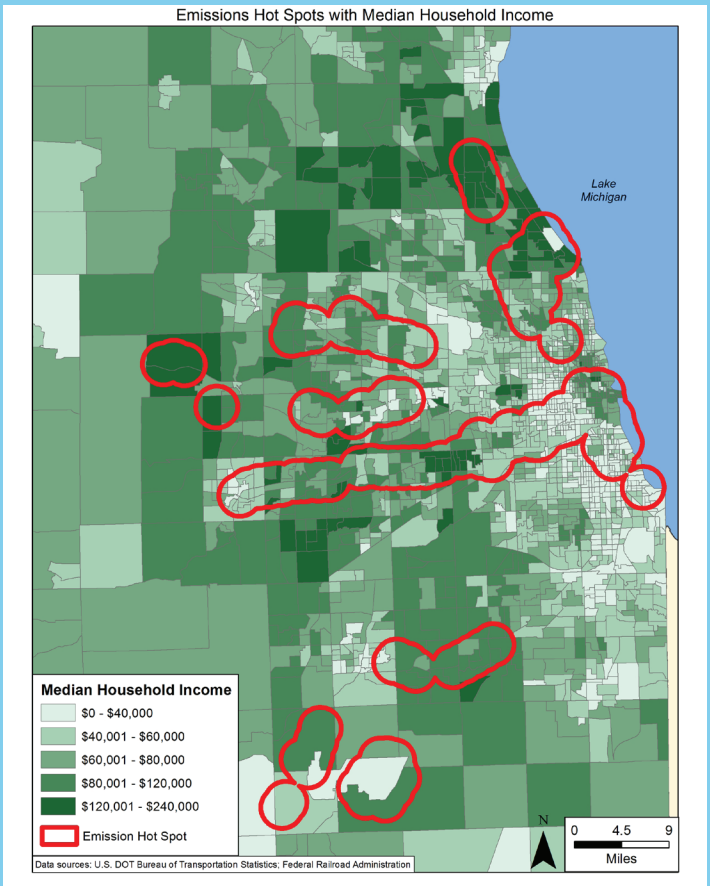
University of Illinois at Chicago

Project: Dynamic Modeling of Railroad Vehicles and Vehicle-Track Interaction

This project develops new computational multibody system (MBS) procedures for the systematic and efficient dynamic modeling and virtual proto-typing of complex railroad vehicle systems, including both vehicles and infrastructure. It is a collaborative effort of mechanical engineers, civil engineers and computer visualization specialists. The dynamics of the railroad vehicle during curve and switch negotiations will be examined, taking into consideration the effect of track and other infrastructure details. This requires integration of geometry, MBS methods, and finite element algorithms. Such advanced modeling and visualization techniques will contribute to greater railroad vehicle safety and to education of future railroad engineers.

Project: Environmental Impact Assessment (EIA) of Rail Infrastructure

This project aims to advance the existing EIA and rail services by providing a system view of sustainability and a one-stop database in a Geographic Information System (GIS). The project team will further refine the "Sustainable Rail Scorecard" that addresses the efficiency, safety, public health, environmental sustainability, and livable community goals of rail infrastructure management. The metrics in the scorecard incorporate recent academic research as well as pertinent legislation and government guidelines. It provides the technical basis and practical guidance for quantitative models of EIA. The project was led by Dr. Ning Ai, Assistant Professor, Urban Planning and Policy, with assistance from Marcella Bondie and Anthony Grande The researchers have connected emission impacts with neighborhood background information, such as land use and demographic characteristics. The team will continue to refine and validate location-specific models by exploring multiple approaches. The work will be presented at the Joint Rail Conference in April 2013 and Transport Chicago Conference in June 2013.



Map showing rail emission hot spots overlayed on income data for the northeast Illinois region from the Environmental Impact Assessment project.

James O'Shea

James O'Shea earned Bachelor of Science and Master of Science degrees at UIC and is currently pursuing his Ph.D. in Mechanical Engineering. As an undergraduate he participated in internships and other programs with organizations such as Caterpillar and NASA Airborne Science where he began to develop a growing interest in vehicle dynamics. James began to focus on rail research and is currently studying vehicle stability and wheel/rail interactions during derailment scenarios. He hopes to contribute to the analysis and prevention of vehicle derailments. James has presented his work at several conferences and some of this work has been published in ASME Transactions. He has also served as a reviewer of technical papers submitted to ASME conferences as well as IMechE and ASME Transactions.

Massachusetts Institute of Technology

Project: Using Advanced Quantitative and Qualitative Tools to Create New Insights about HSR

The objective of this project is to develop a deeper understanding of HSR – initially in the United States but ultimately abroad – in various corridors and network configurations. The project will bring a variety of quantitative and qualitative tools to bear on this area and shed light on decision making in the HSR context. There are technological issues, system architecture issues and institutional issues that must be dealt with as a function of the particular implementation and of the nation within which it is taking place.

The method of choice to study these issues is the CLIOS Process (CLIOS stands for Complex, Large-Scale, Interconnected, Open, Sociotechnical), which has been built up over many years of research at MIT. The work on this project has thus far focused on Amtrak's Northeast Corridor (NEC), the most densely settled corridor in the country and one of its most important – if not the most important – economic engines. The NEC was selected because of the reasons noted above but also because many observers believe it is the area of the U.S. in which HSR implementation would make the most economic sense. The institutional context is exceptionally difficult as the corridor passes through eight states and a number of major cities including Boston, Providence, New York, Philadelphia, Baltimore and Washington. There is also a legacy system in place including the Acela Express, the only service in the U.S. that approaches international quality high-speed rail.

MIT researchers continue to delve more deeply into the various issues the initial research uncovered. In addition, they have focused on the economic productivity of the current rail passenger system in the NEC and have projected what improvements in productivity might be reasonably expected.

The research team, http://web.mit.edu/hsr-group, believes that many high-speed rail analyses don't adequately consider the large-scale regional development enabled by high quality surface transportation between cities that are less effectively connected currently (e.g. by air, highway and conventional rail). This enhanced connectivity can lead to larger and more integrated commercial and labor markets and could prove economically beneficial to the region and the nation at large.

Future research will take this framework and apply it in other potential HSR corridors in the U.S., such as corridors considering Chicago as a hub in the mid-west and the California HSR implementation.

Amtrak's flagship Acela Express trainset at Princeton Junction, NJ.

S. Joel Carlson

Originally from Prince Rupert, BC, Canada, S. Joel Carlson became interested in the transportation field while interning at the Prince Rupert Port Authority. Joel is a dual Master of Science in Transportation and Engineering Systems student and works in Joseph Sussman's Regional Transportation Planning and High-Speed Rail Research Group at MIT where he studies HSR using the CLIOS Process considering both institutional and technical issues. His research work focuses on the challenges of implementing HSR in the NEC using the CLIOS Process, along with scenario planning and real options analysis, to help characterize and manage the uncertainties associated with long-term planning.

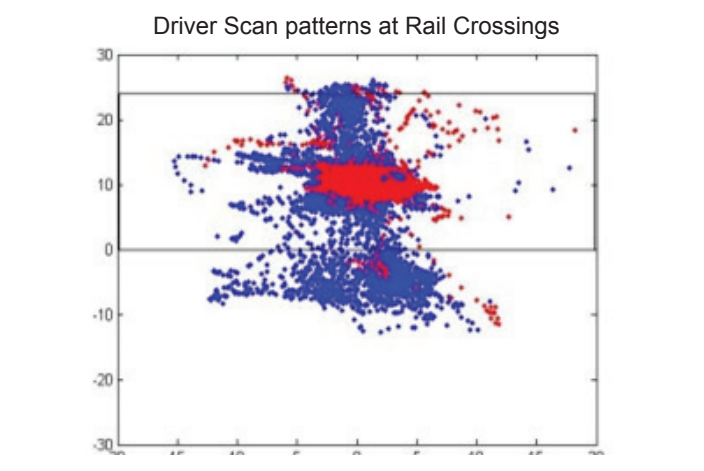
During his first summer term after beginning at MIT, Joel worked for two months with the SNCF in Paris, France, where he was exposed to France's impressive efforts at making HSR an integral component to the overall transportation system. That same summer, he was also given a scholarship to attended UIC's 8th World Congress on HSR in Philadelphia, PA where he received second place for his essay submission to the conference.

Joel received his Bachelor of Science in Civil Engineering from the University of Alberta in 2011, where he received the Governor General's Silver Academic Medal, as well as the Rt. Hon. C.D. Howe Memorial Fellowship, the University of Alberta's highest monetary award for graduating students.

Michigan Technological University

Project: Creating Scanning Pattern Maps of Driver Fixations during Hazards

This project presents a method using simulated railroad situations as a hazard-medium to create driving scan pattern maps over the course of a long drive. Previous research shows that drivers only look for a train about 33% of the time at railroad crossings. With driver inattention composing a large proportion of reported accidents, there exists a need to be able to quantify exactly what a driver fixates on over the course of a drive.



The graph shows the time period at each railroad track (red) overlaid on the tracking for the entire course. These subjects were subjected to a train at the first railroad crossing.

Each subject was exposed to a virtual road environment via a medium fidelity driving simulator. This environment was a rural course approximately 12 miles long created using the NADS MINISIM software in which there were four railroad crossings. Data was also collected via the FaceLab eye-tracker system and analysis was performed via custom MATLAB programs. The output from the driving simulator (braking force and driver speed) was analyzed for both crossing zones and regular driving.

It was found that the expert group exhibited a wider scan pattern than the novice group, as well as shorter fixations when fixations did occur, indicating the driver processed more information in less time. It is expected that future research will confirm that patterns will develop differently for drivers expecting a train and experienced drivers who know what to look for.

Project: Shared Corridor Capacity

A growing interest exists in the U.S. to operate higher speed passenger rail service on corridors shared with freight rail. Shared corridors are challenging, particularly in terms of reliability of service and capacity availability, due to high heterogeneity. The projected growth in demand for rail transportation is likely to exacerbate the situation. Similar to the U.S., European passenger rail services are generally operated on shared-use corridors. However the infrastructure conditions and the operational priorities and patterns usually allow more reliable and higher speed passenger operations in comparison to the U.S. systems.

Capacity and simulation software is used to analyze capacity allocations and operational limitations. However, the impacts of software selection haven't been investigated. This research evaluates different U.S. and European simulation tools to examine shared-use corridors based on different scenarios, including a hybrid approach, on a single case study. It also applies a timetable compression technique (European approach) along a U.S. shared-use corridor.

Hamed Pouryousef

Hamed Pouryousef is a graduate student pursuing his Ph.D. in Civil and Environmental Engineering under the supervision of Pasi Lautala. Hamed earned a Bachelor of Science degree in Railroad Engineering from the Iran University of Science and Technology in 2001. He then joined Metra Consultant Engineers, affiliated with the Iran Department of Transportation, where he was involved in several rail and transportation projects for eight years before joining the Lisbon based MIT-Portugal Master of Science Program in 2008. After graduation in 2010, Hamed moved to Michigan Tech. In addition to his research work on railway capacity, Hamed has been the technical lead to a federally funded project "HSR Workforce Development through Online Education and Training" and has been the instructor for the Rail Transportation Seminar course at Michigan Tech. Hamed is a member of TRB Committee AR060 (Railway Maintenance)

and is an active AREMA student member in Committee 16 (Economics of Railway Engineering & Operations) and Committee 17 (High Speed Rail Systems) since 2010.

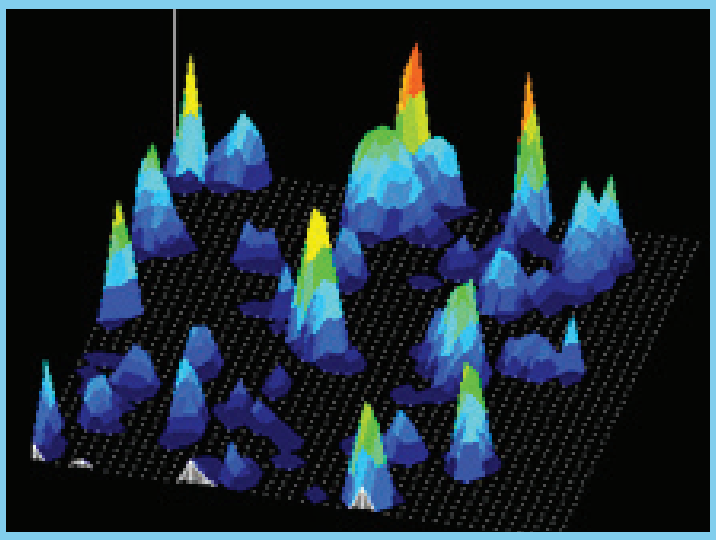
University of Kentucky

Project: Ballast-Tie Interface Pressure Measurement

The ballast-tie interface in the railroad track structure plays an important role in overall track stability. The interface initializes the distribution of the high loads carried by the ties into the ballast bed and must provide sufficient lateral and longitudinal support of the superstructure. The interface is characterized by high point loads between individual ballast particles and the tie. These high point loads can contribute to ballast degradation and reduced track support.

In-situ Tie-Ballast Monitor

In partnership with the Transportation Technology Center, Inc. (TTCI) in Pueblo, CO, a research project was undertaken to better understand this behavior. The goal of this research is to develop a stress based methodology for the characterization of the ballast-tie interface. The proposed method will allow areal and temporal stress distribution at the interface to be measured using Matrix Based Tactile Surface Sensor (MBTSS) technology that allows the pressures on individual ballast particles to be observed. Thus far, the effects of various ballast gradations have been studied and initial field testing has taken place. The proposed methodology can be implemented in a life cycle analysis to observe the changes in pressure distribution, peak pressure, contact area, and ballast gradation over time. A better understanding of how the ballast-tie interface behaves will have implications in ballast degradation modeling, tie design, and the effectiveness of premium track components such as half-frame ties and under-tie pads.



3D Tie-Ballast Pressure "Heat-map" (Image from Tekscan software)

Mike McHenry

Mike McHenry earned a Bachelor of Science degree in Civil Engineering at UK and is currently pursuing a Master of Science degree under the guidance of Jerry Rose with a focus on geotechnical and railroad engineering. His interest in railway engineering began in the front row of Professor Rose's Railway Engineering course in the spring of 2010 and soon after he became an undergraduate research assistant. His interest in track design and geotechnical engineering continued to grow, especially with regards to ballast fouling and railroad subgrade issues. His research seeks to develop a methodology to measure the pressure distribution at the interface of the tie and ballast.

With his unique interest in railway engineering and geotechnology, Mike was named a Dwight David Eisenhower Transportation Fellow and was also awarded a Wethington Fellowship from the University of Kentucky Graduate School. Mike is the founding president of RailCats, an AREMA student chapter at UK formed in 2011. He has also participated at national and international technical conferences, industry committee meetings, and a recent internship at the TTCI in Pueblo, CO.

University of Tennessee, Knoxville

Project: Assessment of Existing Railroad Bridges to Accommodate a Higher Speed Considering Chinese Practices

The objective of this project is to investigate how railroad bridges might be modified to permit higher train speeds in shared corridor operations. The researchers will initially study Chinese methods and technology concerning speed upgrades of existing railway bridges. They will then examine the degree to which these Chinese practices have application to speed upgrades on U.S. railway bridges.

The first part of this project was completed in November 2012. Researchers visited four Chinese institutes and consulted with specialists who participated in the six speed upgrades of existing railways. The collaborating institutions included the China Academy of Railway Sciences (CARS), China Railway Publishing House, the Zhengzhou Design Institute of China Railway Engineering Consulting Group Co., Ltd., and China Major Bridge Engineering Co., Ltd. The team has gathered information on the theoretical analysis and practical technology developed during China's railway speed upgrades, the decision-making principles and design methods of strengthening and retrofitting existing railway bridges for these speed upgrades, and the knowledge and experience concerning the most economical and effective methods of strengthening and retrofitting different types of railway bridges. Team members conducted a literature review of Chinese books, technical papers, and design codes.

During field visits, the research team studied the construction technology developed for strengthening and retrofitting existing railway bridges to meet the requirements of speed upgrades. Special attention was given to the construction methods and technology that could minimize the influences of bridge strengthening and retrofitting on normal operations of railways in the U. S.

The research team also conducted field surveys to investigate bridges strengthened and retrofitted for speed upgrades. Bridges in the Beijing-Guangzhou corridor were selected based on their superstructure types. The team obtained bridge design standards, operating speeds, foundation conditions, load capacity ratings, and strengthening and retrofitting methods. The figure shows one of the retrofitted bridges that the team examined.

Currently, the PI and associates are compiling a report on the experience gained in China. In the second project phase, they plan to investigate existing railway bridges in the U. S. and determine what Chinese experience and technology might be suitable for speed upgrades of these bridges.

Concrete girders retrofitted by using transverse prestressing forces.

Ying Zhang

Ying Zhang started her Ph.D. study in August 2012 at UTK and was immediately involved in the railroad routing and capacity research funded by NURail. She is advised by Dr. Mingzhou Jin and affiliated with the Logistics, Transportation, and Supply Chain lab at UTK. She has finished the literature review of railroad capacity study. Based on the work of prior students in the lab, Ying has worked on algorithms to route rail traffic under congestions, which is critical to evaluate capacity of a railroad network. When a network is operated close to its capacity, the travel time on links and the volume at yards could be heavily impacted or limited.

Ying will present preliminary results at the Joint Rail Conference 2013 that will be held in April. In addition, she will submit another journal paper in Spring 2013. Ying received a Master's degree of Management Science and Engineering from Yanshan University in China in 2009 and a B.S. of Industrial Engineering from Tianjin University in China in 2006. She recieved the Excellent Graduate award by Yanshan University in 2008 and received the Outstanding Student Leader award and the Renmin Scholarship during her undergraduate study at Tianjin University.

Rose-Hulman Institute of Technology

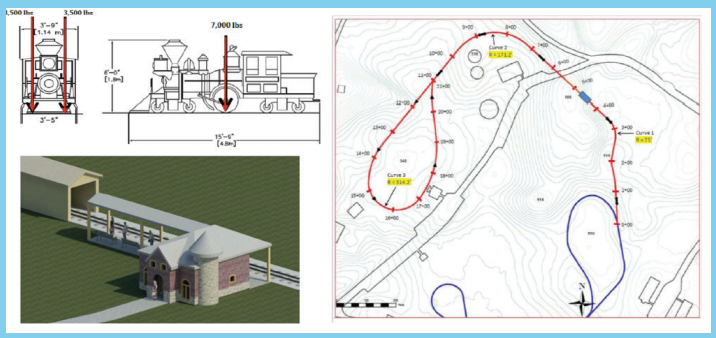
Project: CE 490 Railroad Engineering

The objective of this NURail Center funded project is to develop the curriculum for and offer an introductory course on Railroad Engineering. The course will be interdisciplinary with assistance from the Electrical and Mechanical Engineering departments. Topics to be covered in the ten week, forty class meetings include: Introduction to the Rail Industry; Rolling Stock; Locomotives; Rail Power; Safety; Track Structure and Geometry, Turnouts and Switches; Controls and Signals; PTC; Classification Yards and Terminals; Passenger Rail; High Speed Rail; MOW; and the Future of Railroad Engineering. Prof. James McKinney will teach the first class in the Spring 2013 semester with expected enrollment from civil and mechanical engineering students.

CE 490 Railroad Engineering - CE/ME/EE Interdisciplinary Course

Project: Senior Capstone Project

Additionally, four civil engineering students are involved in a year-long senior capstone design project which will be completed at the end of the 2012-2013 academic year. Working with the Indiana Rail Road and the City of Terre Haute Parks Department, the project will double the length of The Spirit of Terre Haute, a miniature park railroad, to include a park road grade crossing, a low level trestle, a boarding platform, a historic Terre Haute terminal replica, as well as the environmental and sustainability aspects of the project.



Students in Rose-Hulman's CE 489 Senior Design course used railway engineering fundamentals to design a 2,100-foot extension to the miniature steam railway in Deming Park, including a replica of the historic Terre Haute "Big Four" depot.

Greg Frech and Sam Beck

Greg French is a junior Civil Engineering student from Lake Zurich, IL. He spent the summer of 2012 as a NURail Center undergraduate intern at UIUC working on the concrete cross tie project. Greg will be interning in 2013 with the Moffitt and Nichol Rail Division in Raleigh, NC. He was awarded the 2013 AREMA Committee 27 - John Deere Scholarship.

Sam Beck is a junior Mechanical Engineering student from Hammond, IN. Sam interned at the Norfolk Southern's Portsmouth, OH car shop during the summer of 2012 and will return there in 2013. He is the author of the book The Indiana Harbor Belt Railroad in Color. Sam was awarded the 2013 AREMA President's Scholarship.

Greg and Sam are the founding officers of the Rose-Hulman AREMA student chapter with Greg serving as Chapter President and Sam serving as Chapter Vice President. Through their leadership, the student chapter grew to 17 members. They conducted seven monthly meetings and participated in seven railroad field trips/site visits which included the Wabash Valley Railroaders Museum; Indiana Harbor Belt Railroad; Amtrak Beech Grove Shop; Indiana Transportation Museum; Indiana Rail Road Hiawatha Yard; the Indiana Rail Road Indianapolis intermodal terminal; and an Indiana Rail Road rail sliding project.

Greg Frech (left) and Sam Beck (right)

Completed and Ongoing Projects

NURail Research Projects

University	Project Title	Principal Investigator	Start Date	End Date
MIT	High-Speed Rail as a Complex Sociotechnical System	Sussman	02/01/13	01/31/14
MIT	High-Speed Rail Productivity	Sussman	09/01/12	08/31/13
MTU	Austempered Ductile Iron (ADI) for Railroad Wheels	Sanders	01/31/12	01/31/14
MTU	Assessment of Aggregate Sources in Michigan for High Speed Railroad Ballast	Vitton	06/01/13	12/31/13
MTU	Influence of Driver Attention on Rail Crossing Safety	Hill	05/01/12	01/31/14
MTU	Cross-Infrastructure Learnings for Alternative Bridge System Designs – A Case Study on the Hybrid Composite Bridge System	Harris (UVA)	10/01/12	01/31/14
MTU	Improving Rural Freight Rail in the State of Michigan	Lautala	11/01/13	01/31/14
UIC	Modeling of Rail Track Substructure and Rail Vehicle Energy Dissipation	Foster	05/01/12	01/31/14
UIC	Rail Infrastructure Materials for High Speed Rail	Issa	05/01/12	01/31/14
UIC	The Informed Railroad Traveler (Smartphone Application)	Wolfson	05/01/12	01/31/14
UIC	Immersive Visualization of Rail Simulation Data	Leigh	05/01/12	01/31/14
UIC	Integrated Dynamic Modeling of Rail Vehicles and Infrastructure	Shabana	05/01/12	01/31/14
UIC	Environmental Impact Assessment of Rail Infrastructure	Schlickman, Ai	05/16/12	12/13/13
UIC	Railroad Grade Crossing Pedestrian Safety	Schlickman, Sriraj, Metaxatos	06/01/12	01/31/14
UIC	Value Capture Strategies for the Funding of Rail Construction and Operation	Schlickman, Smith	06/01/12	12/31/13
UIC	Economic Benefits of Productivity Increases through Truck-to-Rail Mode Shift in Freight Transport	Kawamura	08/01/12	01/31/14
UIUC	Concrete Crosstie Fastener Sub-System Testing and Modeling	Edwards, Dersch, Kernes	05/16/12	12/31/13
UIUC	Railroad Grade Crossing Micro-Level Safety and Risk Analysis	Benekohal	08/15/12	08/15/13
UIUC	Improving Track Substructure Designs and Settlement due to Complex Dynamic Loads from High-Speed Passenger and Freight Trains	Tutumluer	08/01/12	12/31/13
UIUC	Development of a 3D FEM Model for Concrete Tie and Fastening Systems	Andrawes	05/01/12	01/31/14
UIUC	Impact of High-Speed Passenger Trains on Freight Train Efficiency in Shared Railway Corridors	Dick	05/01/12	01/31/14
UIUC	Causal Analysis of Passenger Train Accidents on Freight Rail Corridors	Saat	05/01/12	01/31/14
UKY	Impact of Lock and Dam Closures on Rail System	Souleyrette	06/01/12	05/31/13
UKY	A National Survey of Commuter Rail Policy - Shared Corridors	Souleyrette	03/01/12	08/31/12

UIUC - University of Illinois at Urbana-Champaign; UIC - University of Illinois at Chicago; MIT - Massachusetts Institute of Technology; RHIT - Rose-Hulman Institute of Technology

NURail Research Projects

University	Project Title	Principal Investigator	Start Date	End Date
UKY	3D Methodology for Evaluating Rail Crossing Roughness	Souleyrette	05/01/12	01/31/14
UKY	Rail Life-Cycle Performance Studies	Rose	05/01/12	08/31/13
UTK	Assessment of Existing Railroad Bridges to Accommodate a Higher Speed Considering Chinese Practices	Ma, Clarke	06/01/12	11/30/13
UTK	Lateral Impact of Railroad Bridges with Hybrid-Composite Beams	Bennett, Ma	07/01/12	12/31/13
UTK	Development of New Damping Materials for Ballastless Trackbed and their Behavior under Mixed Traffic	Huang	07/01/12	12/31/13
UTK	Evaluation of Terminal Capacity Models for Rail Freight Flow Analysis	Clarke, Jin	09/01/12	12/31/13

NURail Education Projects

University	Project Title	Principal Investigator	Start Date	End Date
MTU	Rail and Intermodal Transportation Summer Youth Program	Lautala	06/01/12	07/31/13
MTU	Railroad Engineering Education Symposium (REES) 2012	Lautala	05/01/12	06/30/12
MTU	Undergraduate Student Projects	Lautala	08/01/12	01/31/14
MTU	Undergraduate Certificate in Rail Transportation/Engineering	Lautala	08/01/12	01/31/14
MTU	Michigan Rail Conference	Lautala	06/01/13	09/30/13
MTU	Converting Rail Course(s) to On-line Format	Lautala	05/01/12	01/31/14
RHIT	Development of Interdisciplinary Undergraduate Railroad Engineering Course	McKinney	02/01/12	01/31/14
UIC	METRA Management Training	Prevera	09/01/12	06/30/13
UIUC	Hosting Home Schoolers Visit to Expose to Railroad Engineering	Edwards	03/01/12	05/31/12
UIUC	Develop and Teach Graduate Course in Shared Rail Corridor Engineering and Transportation	Barkan, Saat	01/01/12	07/31/12
UIUC	Develop and Teach a Senior-Level Course on High-Speed Rail Planning	Saat, Kao	08/01/12	12/31/12
UIUC	Develop and Teach a Senior-Level Course on High-Speed Rail Construction Management	Saat, Kao	11/01/12	05/31/12
UIUC	Railway Transportation Engineering Course Updates	Barkan, Dick	08/01/12	12/31/13
UIUC	Railroad Design and Construction Course Updates	Dick, Edwards	10/01/12	05/31/13
UKY	REES Module and Intermodal Course Enhancement	Rose	05/01/12	05/31/13
UTK	Develop Railway Engineering Modules for Materials Courses	Huang	07/01/12	12/31/13

MTU - Michigan Technological University; UKY - University of Kentucky; UTK - University of Tennessee, Knoxville;

Selected 2012 Publications by the NURail Consortium

Chadwick, S., M.R. Saat and C.P.L. Barkan. 2012. Analysis of factors affecting train derailments at highway-rail grade crossings. In: Proceedings of Transportation Research Board 91st Annual Meeting, Washington, D.C., January 2012.

Escalona, J.L., H. Sugiyama and A.A. Shabana. 2012. *"Effect of Structural Flexibility in Railroad Vehicle Systems," Technical Report No. MBS2012-4-UIC*, Department of Mechanical and Industrial Engineering, University of Illinois at Chicago, December 2012.

Khaled, A.A., M. Jin, D. Clarke and M. A. Hoque. 2012. Determination of criticality of freight railroad infrastructures based on freight flow optimization. In: Proceedings of Transportation Research Board 92nd Annual Meeting, Washington, D.C., January 2013.

Lautala, P.T., D.P. Babbitt and K. Pepin. 2012. Win-win: Shortline railroad and university team up for education and development, In: Proceedings of American Railway Engineering and Maintenance of Way Association Annual Conference, Chicago, IL, September 16-19, 2012.

Lautala, P.T., H. Pouryousef, R. Handler and S. Chartier. 2012. The role of railroads in multimodal woody biomass transportation in Michigan, In: Proceedings of ASME/ASCE/IEEE 2012 Joint Rail Conference, Philadelphia, PA, April 17-19, 2012.

Liu, X., M.R. Saat and C.P.L. Barkan. 2012. Analysis of major train derailment causes and their effect on accident rates. Transportation Research Record 2289: 154-163.

Pagliara, F., J. de Abreu e Silva, J.M. Sussman and N. Stein. 2012. Megacities and High Speed Rail Systems: Which Comes First? In: Wulfhorst and Butter (Eds.) *Transportation Demand Management: Insights from the Mobil TUM 2012 International Scientific Conference on Mobility and Transport.*

Rapp, C., M.S. Dersch, J.R. Edwards, C.P.L. Barkan, J. Mediavilla and B. Wilson. 2011. Measuring concrete crosstie rail seat pressure distribution with matrix-based tactile surface sensors. In: Proceedings of ASME/ASCE/IEEE 2012 Joint Rail Conference, Philadelphia, PA, April 17-19, 2012.

Shabana, A. 2012. Nadal's formula and high speed rail derailments. ASME Journal of Computational and Nonlinear Dynamics 7 (4) 8 pages.

Specchia, S., A. Afshari, A.A. Shabana and N. Caldwell. 2012. A train air brake force model: Locomotive automatic brake valve and brake pipe flow formulations. Journal of Rail and Rapid Transit 227 (1): 19-37.

Sussman, J.M. and N. Stein. 2012. Discontinuous regions: High speed rail and the limits of traditional governance. In: Proceedings of Transportation Research Board 92nd Annual Meeting, Washington, D.C., January 2013.

Sussman, J.M., A.F. Archila, S.J. Carlson, M. Pena-Alcaraz, N. Stein and R.J. Westrom. 2012. *"NEC FUTURE Tier 1 Scoping Process: Public Comment"* Regional Transportation Planning and High Speed Rail Research Group, Massachusetts Institute of Technology, Cambridge, MA.

Zeman, J.C., J.R. Edwards, D.A. Lange and C.P.L. Barkan. 2012. Hydraulic pressure cracking in rail seats of concrete crossties. ACI Materials Journal 109: (6) 639-646.

Strategic Development Planning

The NURail Center research program is comprised of two major parts, the Strategic Development Plans (SDP) and the Technical/Educational Research Projects. Strategic development planning involves collaboration among the NURail Center partners to develop the long-term vision, essential tasks and the timeline for specific thematic research topics. In essence the SDP guides the development and selection of future research projects. Major tasks include establishing working groups consisting of the leaders in related fields from NURail Center partner institutions; identifying the state of the art and practice from previous or current research efforts, and organizing symposia on SDP topic areas with team members and outside researchers providing updates on recently completed or on-going research projects.

The process to create Strategic Development Plans for six thematic research topics began in 2012. The plans will focus on three key areas needed to advance the state of the art and practice in railway research.

- Develop a Research Blueprint: Identify the current state of the art and practice; solicit stakeholder input on research needs; develop a long-term vision for the direction of research; organize and establish priorities for the research needs in the topic area; develop a timetable for the proposed research; distill priority research needs into project tasks that can be funded through NURail or other sources; and aid in the development of future UTC proposals via the research blueprint for future topic areas.
- Promote Internal NURail Collaboration: Assist in guiding the overall NURail strategic plan by identifying synergies with other SDPs and key research questions and themes; coordinate response to open calls for research projects from various programs (e.g. AAR Tech Scanning, FRA Strategic Research Initiatives etc.); forge ready-made teams to respond to requests for proposals on research topics (e.g. cooperative research programs or various other federal and state initiatives); serve as a consortium-wide resource with expertise in the research topic areas; market domain knowledge and expertise in ongoing research to industry, practitioners and other academics; and facilitate and coordinate NURail representation on committees and other organizations related to the research topic area.
- Engage Industry Stakeholders: Establish industry working groups; develop presentations for industry association conferences; author whitepapers on pertinent research topics and results; organize workshops and symposia in thematic research topic areas; and author and submit journal articles for publication.

The NURail Center leadership team identified the need for SDPs in the following six thematic research topics areas:

1. Integrated Rail Vehicle-Track Interaction and Dynamics
2. Railroad Safety and Risk on Shared Passenger and Freight Rail Corridors
3. Railroad Network Capacity Analysis and Planning
4. Urban, Regional and High-Speed Passenger Rail Implementation
5. Multimodal Freight Transportation
6. Funding, Finance, Community and Economic Development

Work was begun on each SDP including a workshop being held on Topic 1 at UIC in September 2012.

Selected 2013 Events

February 15 – William W. Hay Seminar presentation by Michael Iden, Union Pacific Railroad, Urbana, IL.

February 19 – Michigan Tech Railroad Day, Houghton, MI.

March 23-25 – Seminar by Joseph Sussman, East Japan Railway Company Research and Development Center, Omiya, Japan.

April 15-18 – Joint Rail Conference, hosted by NURail co-Principal Investigator, David Clarke and the University of Tennessee, Knoxville, TN.

April 26 – Presentation by Pasi Lautala at 2nd UIC World Congress of Rail Training, Vienna, Austria.

April 26 – William W. Hay Seminar presentation by Sebastian Stichel, Royal Institute of Technology (KTH), Urbana, IL.

May 13-15 – Participation in the Int'l Association of Railway Operations Research Conference, Copenhagen, Denmark.

June 7 – Presentations at the Transport Chicago Conference, Chicago, IL.

June 18 –William W. Hay Seminar presentation by Gilles Saussine, SNCF, Urbana, IL.

July 7-13 – Summer Youth Program in Rail and Intermodal Transportation at Michigan Tech, Houghton, MI.

August 13 – NURail Strategic Development Planning meeting, Louisville, KY.

August 27 – First Michigan Rail Conference, Houghton, MI.

September 11-12 – NURail Annual Meeting, Urbana, IL.

Fall – Call for research and education project proposals.

November 5-6 – 15th Annual RREC, Urbana, IL.

December 6 – William W. Hay Seminar presentation by Anthony Perl, Simon Fraser University, Urbana, IL.

International Collaboration

University of Illinois at Urbana-Champaign

In a collaborative effort with the Swedish Royal Institute of Technology (KTH), Swedish students participated online in the UIUC HSR Planning course. Planning was also completed with KTH for a Rail Vehicles Dynamics class to be taught at UIUC in the Spring 2013 semester by visiting KTH faculty and NURail Center faculty.

Several NURail Center principals made a two-week trip in 2012 to China, South Korea and Japan to meet with government agencies, railroad companies, rail suppliers, rail research organizations and university rail engineering and transport programs to establish cooperative research and educational relationships.

RailTEC Concrete Crosstie and Fastening System researchers and faculty from the Technical University of Munich visiting a German slab track manufacturing facility.

The infrastructure research team at UIUC is working with the Technical University Munich (TUM) on the design and performance of fastening systems. The two organizations are finalizing a Memorandum of Understanding to further collaborative efforts in the area of concrete crossties and fastening systems. TUM and UIUC are leaders in the area of track superstructure research, and continued efforts to collaborate on research are being pursued that will serve the international railway community.

University of Illinois at Chicago

UIC collaborated with the University of Seville in the area of railroad vehicle dynamics resulting in a technical paper to be published in 2013 in the Journal of Vehicle System Dynamics. UIC has also collaborated with Milan Technical University during 2012, with four students from Milan working at UIC Dynamic Simulation Laboratory in the area of railroad vehicle dynamics. Future technical papers will document this collaboration.

Massachusetts Institute of Technology

MIT has two active international rail activities. Joseph Sussman who has a chair endowed by the East Japan Railway Company has been working with that company for more than twenty years. Recent discussions have focused on JR East aspiring to be an international provider of high-speed rail technology and organizational know-how. The idea is to develop a conceptual framework they can use to evaluate various opportunities available to them.

Their second major involvement is through the MIT-Portugal Program (MPP). This program has funded Professor Sussman's group to study the potential for HSR in that nation. They have studied questions surrounding regional economic development that might be enhanced by HSR of international quality leading to the creation of so-called "mega-regions", larger economic zones that permit broader labor markets as well as commercial markets to be developed. This program has been ongoing since 2010, funded by FTC, the Portuguese equivalent of the National Science Foundation.

Proposed HSR network for Portugal: two views

University of Tennessee, Knoxville

UTK hosted three visiting scholars from Beijing Jiaotong University, Dr. Haodong Li, Ms. Jinzi Zheng and Dr. Minshu Ma. UTK faculty visited Asia in 2012 to explore collaborations with Beijing Jiaotong University, Nanjing University of Technology, Zhejiang University, Southwest Jiaotong University, Korean Rail Research Institute, KORail, and East Japan Railways. In addition, faculty members at UTK and Beijing Jiaotong University, Nanjing University of Technology, and Zhejiang University are collaborating on papers. While in China, David Clarke delivered talks at Nanjing University of Technology and Zhejiang University.

Note: All overseas activities mentioned in this report were supported with NURail matching funds or other sources.

Shared Corridors: Shared Challenges

The US DOT is supporting development of substantially expanded and improved passenger rail service on a number of intercity corridors. Many of these corridor development projects aim to accommodate faster and more frequent passenger train operation, often on trackage owned and operated by heavy-axle-load freight railroads. Successfully combining these two distinct services on the same rail infrastructure, termed a shared rail corridor, raises a host of technical, operational, organizational, and societal questions and challenges. For these reasons, the NURail Center selected the theme "Shared Corridors: Shared Challenges" in recognition that the challenges of shared corridors represent an opportunity for significant research contributions to the rail industry.

NURail Center research related to the challenge of shared corridors starts from the ground up – literally. Maintaining the track geometry tolerances required to operate passenger trains at higher speeds while simultaneously supporting the axle loads of heavy-haul freight trains places extreme demands on the track structure. Of particular concern are the interfaces between the various components of the concrete crosstie and fastening system. Researchers at UIUC are conducting extensive field testing using innovative instrumentation to characterize the forces and load transfer between the rail, crosstie and individual fastening system components under both passenger and freight train loading. Complimentary research is being conducted at UK where surface sensor technology is being used to investigate the distribution of loads between the bottom of the crosstie and the top of the supporting ballast. Together, the results of these projects will allow railways and track component manufacturers to create new design standards and specifications for the track structure system to optimally serve shared corridors.

Moving higher in the track structure, NURail Center researchers are also investigating the interface between the top of rail and the railcar wheel through vehicle-track interaction dynamics modeling being conducted at UIC and UIUC. This research will support new designs for freight and passenger railcar components that can deliver better ride performance, stability and durability given the track geometry associated with heavy-axle-load freight infrastructure. This research may also lead to improved designs for special trackwork for use on shared corridors.

Closely related but taking a broader systems view, UIUC developed an optimal performance improvement project selection model to be used as a decision support tool that quickly and efficiently evaluates railway corridor running time improvement strategies. The selection model is part of a larger framework for developing rail corridor performance improvement plans that includes network capacity research being conducted at UIUC, Michigan Tech and UIC. These shared corridor capacity research projects are aimed at better understanding how the interaction between freight and higher-speed passenger trains impacts network capacity and how effective various operational and infrastructure investment strategies are at mitigating increases in freight train delay. These projects will enable more cost-effective rail corridor investments in the future.

At the highest level, UIUC is examining the potential safety risks of higher-speed passenger trains on, or adjacent to, freight corridors. UIC and MIT are creating models that better quantify the impact of higher-speed shared corridors on modal split and broader societal transportation habits and land development patterns. These efforts will gain key insights into the economics and benefits of shared corridors that will help shape the future expansion of passenger rail.

Amtrak Lincoln Service operating at 110 mph on the recently upgraded line near Dwight, Illinois.

Developing a New Generation of Railway Professionals

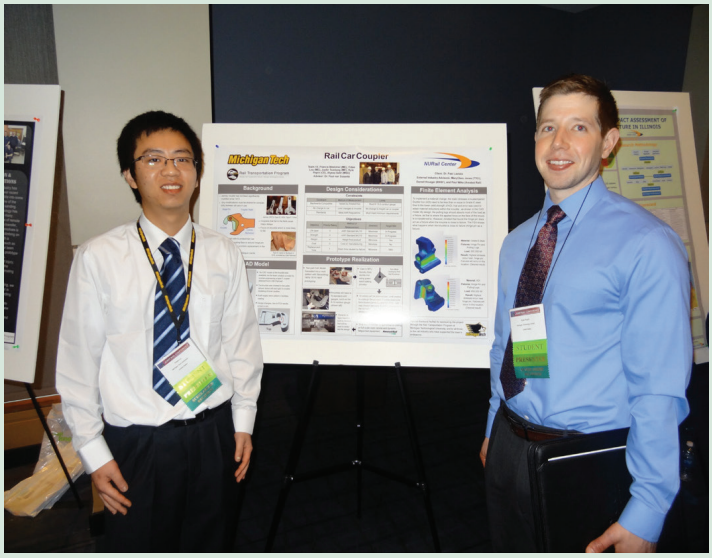
Adapted from TR News, Number 286, May-June 2013: Railroads and Research: Sharing Tracks

The NURail Center is the first US DOT-RITA Tier 1 UTC dedicated to the advancement of North American rail transportation and it seeks to reverse the trend begun in the 1950s which favor air and highway transportation education over rail. This shift led to most engineering graduates in the latter part of the 20th century obtaining their degrees with little, if any exposure to railways.

In its inaugural year, the NURail Center concentrated efforts on promoting renewed faculty and student interest in railway engineering education and research. One of the main objectives for 2012 was to continue leading development of academic content for the Railway Engineering Education Symposium (REES), a collaborative effort with AREMA and other industry groups. REES provides a venue where professors can learn railway fundamentals and are provided with lecture materials on railway topics. The original 2008 event was so successful that it was repeated in 2010 and again following the formation of the NURail Center in 2012. A total of 90 professors have participated in the REES events and, based on follow-up surveys, numerous universities subsequently incorporated REES materials either into existing courses or developed new courses specializing in rail. The NURail Center partner institutions have developed eight new classes that focus on rail, bringing the total number of rail oriented classes to 30.

Graduate students at UIUC use the annual Engineering Open House to introduce rail and intermodal transportation concepts to elementary school students.

Another NURail Center objective is to reach beyond its seven member campuses by expanding online rail course content that can be shared with multiple institutions and establishing an extended group of "NURail Center Affiliate" colleges and universities.



NURail undergraduate students from Michigan Tech present a poster on their railway coupler design project at the Joint Rail Conference.

In other educational initiatives, the NURail Center has facilitated an increasing number of undergraduate student senior design projects on rail topics. Recent examples at Michigan Tech involved the design of railway couplers and a sensor system for locomotive sand tanks, while students at the UIUC prepared a feasibility study and construction management plan for a future HSR line between Chicago and Milwaukee. The NURail Center's reach also extends to K-12 activities in the form of a week-long Summer Youth Program in Rail and Intermodal Transportation at Michigan Tech and rail exhibits at the UIUC Engineering Open House. These particular efforts are led by Pasi Lautala, Tyler Dick and the NURail Education Subcommittee.

Developing the next generation of railroad professionals is the central NURail educational goal. Mentoring NURail students proves to be a rewarding experience for the current generation of railroad engineering experts.

NURail Center Supported Students

A primary mission of the NURail Center is support and encouragement of student interest and study of rail engineering and transport. Some of the students supported by NURail funds in 2012 are described below.

University of Illinois at Urbana-Champaign

Brennan Caughron is an M.S. student in Civil Engineering developing an analytical method to optimize the effectiveness of higher-speed rail corridor capital upgrades.

Thiago Bizarria do Carmo is an M.S. student in Civil Engineering analyzing the shear behavior of rail pad assemblies in the concrete crosstie fastening system.

Chen-Yu Lin is an M.S. student in Civil Engineering analyzing adjacent-track passenger and freight train derailments on shared rail corridors.

Xiang Liu is a Ph.D. student in Civil Engineering developing an integrated safety and risk management framework for hazardous materials transportation by rail.

Alexander Lovett and Greg Munden, M.S. students in Civil Engineering, collaborated on development of a model to optimize high-speed rail network design.

Mei-Cheng Shih is a Ph.D. student in Civil Engineering investigating higher-speed passenger train effects on freight operations and track requirements on shared rail corridors.

Moochul Shin completed his Ph.D. in Civil Engineering modeling the track superstructure in the concrete crosstie and fastening system project.

University of Illinois at Chicago

Mohammad Hosein Motamedi is a Ph.D. student in Civil and Materials Engineering. His research focuses on computer modeling of plastic deformation of porous geomaterials.

Ahmed El-Ghandour is a Ph.D. student in Civil Engineering. He has worked as an TA/RA and has an internship in the summer of 2013 at Sharma & Associates on railroad related topics.

Bo Xu received his Ph.D. from the IGERT Computational Transportation Science program at UIC and is currently a Postdoctoral Appointee at Argonne National Laboratory.

Maen Farhat is a Ph.D. student in Civil Engineering. His research is on the behavior of recycled HDPE plastic ties performing various tests for their use in high speed rail systems.

Ibrahim Lotfy is a Ph.D. student in Civil and Materials Engineering. His research involves testing and performance simulation of HDPE crossties.

Vaihbav Govilkar is an M.S. student working on the 3-D visualization of a railway simulation in a virtual reality environment.

Massachusetts Institute of Technology

Ryan Westrom is an M.S. in Transportation candidate and a 2002 Civil Engineering graduate of UIUC. He is interested in regional planning and the impact of HSR on regional development.

Maite Pena Alcaraz is an Engineering Systems Division Ph.D. candidate interested in network modeling and decision-making under uncertainty.

University of Kentucky

Alex Wang is a Ph.D. student working on structured light applications for 3-D modeling of rail crossings.

Brett Malloy is an M.S. student working on grade crossing finance.

Michigan Technological University

Karl Warsinski is a Ph.D. student studying Austempered Ductile Iron as a potential railroad wheel material.

Alexander Hardy is a Ph.D. student in the Mechanical Engineering department. His research interests focus on mapping human eye fixations in hazardous driving situations.

Irfan Rasul is an M.S. student working on the Michigan Freight Rail Research Study. His master's project investigates the possibilities for collaborative scenarios for rural Michigan rail shippers.

University of Tennessee, Knoxville

Yuan Jing is a Ph.D. student in Civil and Environmental Engineering involved in railway bridge research.

Weiwei Lu, a visiting Ph.D. student in Civil and Environmental Engineering, is working with the bridge research team.

Xin Jiang is a Ph.D. student in Civil and Environmental Engineering focusing on structural research.

John Cabage, a Ph.D. student in Civil and Environmental Engineering, is a member of the bridge research team.

Tyler Rutherford, a Ph.D. student in Civil and Environmental Engineering, is researching damping materials for slab track.

Weiming Song, a Ph.D. student in Civil and Environmental Engineering, is conducting research on slab track damping materials.

Over 75 students from the NURail campuses attended the AREMA Annual Conference in Chicago, Illinois in September 2012. They are shown here after attending a student luncheon and networking event sponsored by AREMA.

U.S. Department of Transportation

Research and Innovative Technology Administration

NURail Center

National University Rail (NURail) Center
University of Illinois at Urbana-Champaign
1239B Newmark Engineering Laboratory, MC-250
205 N. Mathews Avenue
Urbana, IL 61801
217-244-4999 (phone)
217-333-1924 (fax)
NURail-Center@illinois.edu

Visit our website: *http://www.nurailcenter.org*

ILLINOIS UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN | UIC UNIVERSITY OF ILLINOIS AT CHICAGO | MIT Massachusetts Institute of Technology | Michigan Tech | UK UNIVERSITY OF KENTUCKY | THE UNIVERSITY of TENNESSEE KNOXVILLE | ROSE-HULMAN INSTITUTE OF TECHNOLOGY