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Rail Transportation Program Annual Report

Michigan Tech Transportation Institute

2015

Rail Transportation Program Annual Report 2014-2015

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Rail Transportation Program

Michigan Tech Transportation Institute • Michigan Technological University





Rail Transportation Program Vision:

“Develop leaders and technologies for 21st century rail transportation.”

Mission:

“To participate in the development of rail transportation and related engineering skills for the 21st century through an interdisciplinary and collaborative program that aligns Michigan Tech faculty and students with the demands of the industry.”

Director's Message

Year 2014-2015 will be remembered in many ways for Michigan Tech's Rail Transportation Program (RTP). Perhaps the greatest memories are borne out of moments that we experience for the first time and as such, the graduation of our first PhD student, Hamed Pouryousef, was a true highlight for the year. We hope all the best to Hamed, wherever his life takes him after Michigan Tech.

While first experiences are great, it's equally rewarding to see growth and continuation of an event or activity that was initiated through our program. There's no shortage of such activities, but a few of them are especially heart-warming to me as the Program Director. Our annual Railroad Night reached its 10th year; who would have thought that when we crammed 50+ students and faculty to our inaugural event almost a decade ago? In addition to Railroad Night, it has been an absolute delight to see the hard work turn into success for both the Michigan Rail Conference and our Rail and Intermodal Summer Youth Program (SYP).

While we are deeply grateful to our numerous partners help in organizing the programs, neither of them would exist without the RTP. We ought to be proud of our role in attracting new talent to the industry through SYP and in educating our Michigan stakeholders in rail issues.

While the extracurricular activities highlighted in the previous paragraph tend to be near and dear to my heart, we can't forget that RTP has another important mission, the development of new research and technology for the rail industry. While scholarly activities have taken a while to develop, 2014-2015 saw a record number of journal publications, continuing research/project efforts by our undergraduate students and a couple of success stories by our local technology companies. I've always talked about a balanced program and these are certainly all steps to the right direction.

While surrounded by all the success, we can't lose our sight of the challenges either. Last year, one of the major challenges was in the recruitment side and this year hasn't brought improvement to it. Michigan Tech graduates are "hot targets" and it's not easy to convince our youth that the rail industry is the way to go. We have certainly recognized the challenge and we hope that the industry is as eager to start looking for ways to improve, and perhaps even modernize, our recruiting activities. Our collaboration between industry recruiters and RTP resources and perhaps even the career paths offered by the industry are targets to explore. There are plenty of industries who have already caught a running start towards making their recruitment activities innovative and a core company strategy; we probably still have a couple of more steps to climb.

I hope this discussion provides you a good summary on what you'll be finding from the rest of the report and I hope you'll find the time to review the multitude of activities accomplished over the past year. And as usual, if this report doesn't quench your thirst for curiosity, stop by at our web site, www.rail.mtu.edu, for more information and for contact information, if you want to get in touch with us or get involved in Michigan Tech's Rail Transportation Program.



Pasi



Rail Transportation Advisory Board

The Rail Transportation Advisory Board (RTAB) has had a very active year! Seven web-conferences and an onsite meeting provided critical guidance to the RTP Director and staff. Matt Glynn continued on as chair, as did both Darryll Babbitt and Kevin Kesler as Vice Chair and Secretary/Treasurer. Membership remained fairly constant throughout the year, although Greg Garrison replaced Phil Danner as a UP representative, and Alex Lakenen replaced Chris Blessing as REAC president.

The RTAB was instrumental in moving the annual Railroad Night to the fall instead of spring, and in guiding the initial Rail Day and Student Expo. Their efforts ensured a solid industry support for the Rail Day event. They have also provided valuable feedback in the process of looking for sustainable funding for the RTP. RTAB members for this reporting period are listed below with their company affiliations.



Matt Glynn- Chair
-Chief Engineer, Signals & Communications, CN



Darryll Babbitt- Vice Chair
-Fleet Maintenance Manager, The Andersons, Inc



Kevin Kesler
Secretary/Treasurer
Chief of Rolling Stock R&D, FRA



Tim McKay
-Executive VP of Growth & Regional Development, DART



Tim Hoeffner
-Director, Office of Rail, MDOT



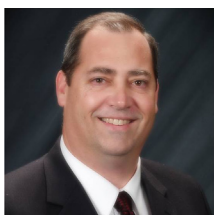
Martita Mullen
-System Manager, Track Standards, CN



Jon Cool
-President, Michigan Railroads Association



Brian Sykes
-Chief Engineer, C&S Engineering, NS Railroad



David Thomson
-President, Engineered Rail Solutions, LLC



Richard Stewart
-Professor, Director, Trans & Logistics Research Center, UW-Superior



Pasi Lautala
Assistant Professor, Director, Rail Transportation Program, Michigan Tech



Alex Lakenen
-President, REAC

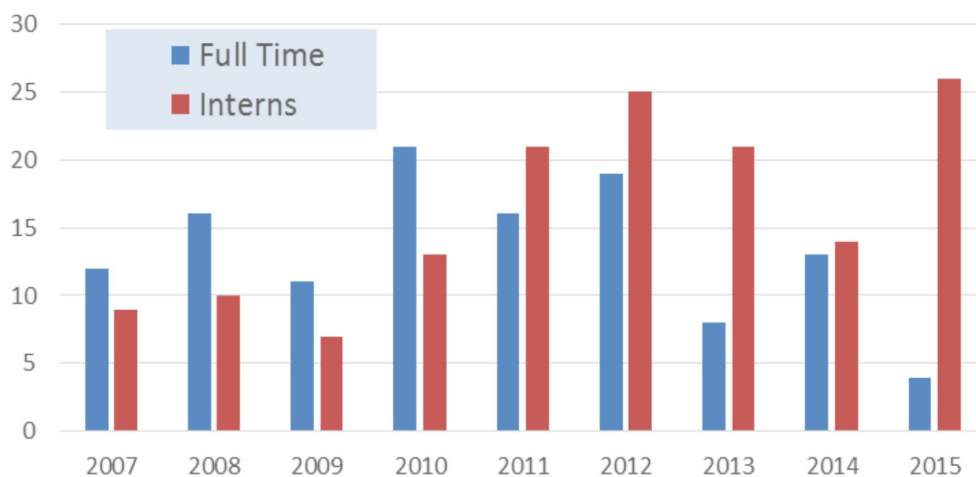
**2014-2015
Program Partners:**



Rail Industry Partners

Rail industry partners continue to be a critical resource for the development of RTP. In addition to funding and other support, CN and Union Pacific, together with numerous other companies are involved in funding, student projects, scholarships, and field visits among other things. All these aspects are indispensable, as we continue toward increased industry visibility on campus.

Thank you for your generous support in 2014-2015!



Rail Industry Recruitment by Calendar Year

RTP continues to work with our rail industry contacts to place students in jobs and internships that will benefit both parties. Competition for talent was fierce in 2014-2015, however we tied our record for industry internships during the summer of 2015. The chart represents our current estimate of internships and hires, although we have learned from the past that in many cases we don't capture all students who end up with the industry until much after their graduation.

SIR

Strategic Internships in Rail

The Strategic Internships in Railroads (SIR) partner program for interested rail industry companies began in 2012. The mission of the SIR program is to create continuous and consistent internship opportunities that introduce RTP students to the rail industry environment and promotes the value of RTP students to rail industry companies. Through their work, the interns actively contribute to advance the company objectives and goals.

**2014-2015
Participating
SIR Companies:**





RTP Faculty & Staff



Dr. Pasi Lautala, P.E.

Dr. Lautala is the Director of the Rail Transportation Program and an Assistant Professor in the Civil and Environmental Engineering Department. For past ten years, Dr. Lautala has been one of the leaders in re-establishing rail transportation education and related research in North American universities. He's an Associate Director of Education for the NURail Consortium, one of the seven members of the State of Michigan Commission for Logistics and Supply Chain Collaboration and Vice Chair of TRB Freight Rail Committee and ASCE T&DI Rail Transportation Committee. He has created and teaches several courses in railroad engineering and is currently involved in numerous funded research projects related to railroads, multimodal transportation logistics and railway engineering education. Before his academic career, Dr. Lautala spent several years in the rail industry in the United States and Finland.



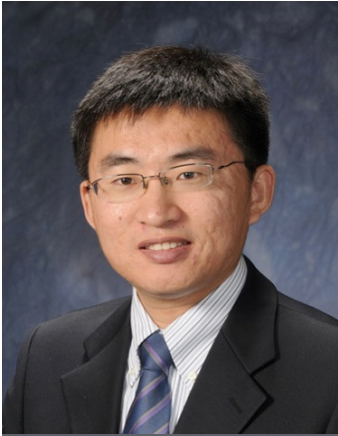
Dave Nelson, P.E.

David Nelson is our Senior Research Engineer and supports activities across the program. Dave has a BS in Civil Engineering and an MS in Mechanical Engineering which will help as we continue to push for multidisciplinary collaboration across the university. He also has an MS in teaching, including seven years of experience in primary and secondary schools. Dave's 20+ years of engineering and management experience with the US Air Force, including a tour teaching at the US Air Force Academy, and his experience from the rail related projects with Maine Department of Transportation bring a unique set of skills and experiences to our program.



Dr. Bill Sproule, P.E.

Bill Sproule is a Professor in the Department of Civil and Environmental Engineering with over 40 years of service in government, consulting, and university research and teaching in Canada and the U.S. He assisted in the development of the current Rail Transportation Program at Michigan Tech and teaches various transportation courses. He has also recently authored a book, *Copper Country Streetcars*. Dr. Sproule's interests include transportation planning, traffic engineering, airport planning and design, public transit, automated people movers, and consulting engineering. Canadian born and a true ice hockey fan, Bill also teaches a class titled "Hockey History and Culture". Dr. Sproule has been recognized with several awards including a Michigan Tech Distinguished Teaching Award and the ASCE Horonjeff Award.



Dr. Kuilin Zhang, P.E.

Kuilin Zhang is Assistant Professor in the Department of Civil and Environmental Engineering at Michigan Tech. Dr. Zhang received his Ph.D. degree in Transportation Systems Analysis and Planning from the Department of Civil and Environmental Engineering at Northwestern University in December 2009. After working as a Postdoctoral Fellow in the Transportation Center at Northwestern, he joined the Energy Systems Division at Argonne National Laboratory as a Postdoctoral Appointee in November 2010. He is a member of Transportation Research Board (TRB) standing committees of Transportation Network Modeling (ADB30) and Freight Transportation Planning and Logistics (AT015). He directs a high-performance computing Laboratory on Sustainable and Intelligent Transportations (SITS-Lab), and teaches transportation planning and transportation systems analysis.



Pam Hannon

Pam Hannon is the Coordinator of the Michigan Tech Transportation Institute and supports the Rail Transportation Program through proposal development and coordination, and research project management.

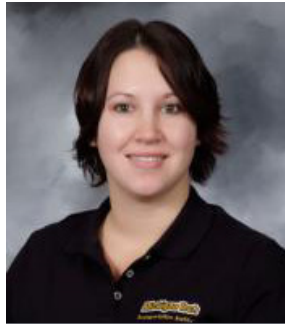


Chris DelReal

Chris DelReal is a 2010 graduate of Michigan Technological University's Computer Networking and System Administration program. He now works with Michigan Tech's Tribal Technical Assistance Program as a web designer, technical advisor and code developer. Chris had a key role in the technical development of the High Speed Rail Learning System.



RTP Welcomes New Staff



Amanda Kerttu

Amanda Kerttu has been working with the Eastern Tribal Technical Assistance Program at Michigan Tech as a staff associate since 2005. She is the primary contact for TTAP clients, manages and coordinates training/events including contracting with facilities, oversees on-site and remote conference/training operations and monitors budgets and projects for externally sponsored research projects. Amanda has recently become a valuable asset to the RTP in assisting with the organization of Michigan Rail Conferences and other industry events.



Aaron Dean

Aaron Dean is an undergraduate Mechanical Engineering major at Michigan Tech. Aside from being involved with REAC, Aaron was recently hired in spring of 2015 as an undergraduate research and administrative assistant for the Rail Transportation Program. Through this position, Aaron has contributed to the RTP with such tasks from graphic design for advertising, assisting graduate students with thesis projects, to developing data reduction algorithms for our naturalistic driving study grade crossing research.



Dr. Hamed Pouryousef

In spring, 2015, Hamed Pouryousef became the first PhD Graduate from the RTP. After his graduation, we were delighted to have Hamed join us as a post-doctorate research fellow, continuing his research on railway capacity modeling. Hamed has also been actively involved in the NURail Student Leadership Committee (SLC) and in various TRB and INFORMS professional committees.

Alumni Highlights

Ryan Hoensheid

Development Engineer, Michigan Department of Transportation Office of Rail

Growing up in Suttons Bay, MI my exposure to the railroad industry was extremely limited and I had no idea of the vast reach of the industry. It was not until I participated in Dr. Lautala's "Summer in Finland" rail education study abroad program in 2009 that I truly began to understand the significance of the railroad industry and the role it plays in the nation's economy. Prior to the "Summer in Finland" my undergraduate studies at Michigan Tech primarily focused around structural design and analysis, but with a new found interest in the rail industry I wished to incorporate both focuses. In 2010 as an undergraduate student I was fortunate enough to have a summer internship with BNSF in Belen, New Mexico on the Abo Canyon Capacity Improvement Project. The Abo Canyon Capacity Improvement Project incorporated my passion for structural design and analysis with 9 bridges and 8.5 miles of new secondary mainline track construction traversing through a narrow canyon pass. After my internship with BNSF I was offered a graduate teaching position at Michigan Tech.



After receiving my Masters of Science in Civil Engineering in 2012 I entered into the private sector and began working as a staff engineer for Cedar Corporation in Menominee, WI. At Cedar Corporation my responsibilities were not rail related but ranged from municipal resident engineering, bridge design, hydraulic design, wastewater design, storm water collection, etc. However in the back of my mind I missed the project scale and fast paced environment the rail industry provides. With that desire to work in the rail industry and on large complex projects, I took my current position as Development Engineer, in December of 2013 with the newly formed Office of Rail in the Michigan Department of Transportation. Within the Office of Rail I work on the federally designated high speed railroad corridor between Detroit and Chicago upgrading the corridor's track structure and signaling system to allow for intercity passenger rail travel up to 110 mph. I am extremely fortunate to be able to be a part of the high speed rail program. The ability to work for the Office of Rail is a very difficult but a very rewarding job requiring me to be aware of all local, state and federal facets affecting the project as well as the engineering fundamentals. The job always presents me with new problems and allows me to continually to grow, both professionally and personally.

Craig Morehouse

General Director Line Maintenance, California Division, BNSF Railway

Growing up in a suburb of Milwaukee I always knew I wanted to find a job with an outdoor element. Summer jobs farming, landscaping and surveying reinforced that feeling. After graduating from high school I applied to and was accepted by Michigan Tech in the Civil Engineering program. While at Tech I was involved with Filmboard and Concrete Canoe. I hadn't considered railroading as an option until I took the transportation, public transit, and construction classes required for my degree ... but those sparked my interest. Having my friend Chad Sherwinski take a position with BNSF four months before my graduation added to the move towards rail. During my last semester at Tech I helped found the Railroad Engineering and Activities Club.



I graduated from Tech in December of 2005, and accepted a job with BNSF. After my initial training I was assigned as an Assistant Roadmaster in Minneapolis, MN. Since then I have moved to positions of increasing responsibility as my career with the railroad has progressed. I've served in the following positions: Terminal Roadmaster Northtown Classification Yard; District Roadmaster Belen, NM; Manager Rail Grinding; Assistant Director Maintenance Production; Division Engineer Chicago; Director Maintenance Performance and Support; and my current position as General Director Line Maintenance California Division. I have moved six times, and lived in states that I never thought of visiting. I've met great people who have taught me a lot about railroading and leading people. In my current role I oversee the engineering department for the California Division of BNSF Railroad. This involves leading approximately 450 employees in the track, structures, and signal departments to safely maintain and upgrade our railroad infrastructure, providing a reliable infrastructure to move passengers and freight on time. While we see most every commodity, the majority of railroad traffic in CA is the intermodal trains coming from the LA ports headed out to the rest of the country. Looking back on the last 10 years, it's been a really enjoyable career so far. I have met a lot of great people, traveled the country, and learned a lot about business. I use my degree on a daily basis, maybe not in the conventional technical side, but rather for the problem solving skills that I developed at Michigan Tech and over the past 10 years.

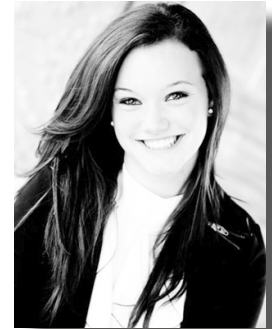


Recent Graduate Highlights

Chelsea Dubrueil

HDR, Inc.

I graduated in May of 2015 with a BS in Civil Engineering and began working for HDR in June with the Transit Rail group in Minneapolis, Minnesota. The group I am working with has led many different transit projects including light rail, street car, and bus rapid transit. Upon graduating from Michigan Tech, I knew I wanted to work in consulting but I had no idea what area I would fit into best. I read about traffic positions and roadway positions and was convinced this was where I would end up. In my last semester, I took CE4407 – Transportation design that covered design aspects of both roads and railways. The amount we learned in this class still amazes me today and while in the class, I began to realize I really enjoyed working on designs and learning all that goes into them. I had never had a class that was as challenging, but also as full of information and hands-on activities. The CE 4407 experience really helped me realize what path I wanted to take for my career, as I had never imagined myself working on railway design before the class and I would have never applied for any jobs in rail without taking this class. I have worked at HDR for about nine months and am learning something new every single day. I have worked on designing multiple turnout options for a streetcar project in Minneapolis. The project I have worked on the most is a Bus Rapid Transit project in Albuquerque, New Mexico. My colleagues have taken their time to train me on AutoCAD and MicroStation and although most of my work at HDR has been in AutoCAD, learning MicroStation during CE 4407 has helped me throughout. I love what I am doing and am grateful for all that I've learned and accomplished so far!



Tom Briggs

CSX Corporation

I graduated in 2014 with a BS in Civil Engineering and then accepted a management trainee position with CSX, working towards a Roadmaster position. I completed my training in September 2015, and was assigned to the Chicago Division as an Assistant Roadmaster. I recently applied for a Roadmaster position on the New Rock sub`division, and will be taking over that territory in February 2016. Before attending Michigan Tech Tom I served in the Marine Corp, and I found that the culture and background for CSX has a lot of parallels with my military experience. One of my earliest lessons in the Management Training program was that the experience of the crew members I work with is invaluable. Although my rail background from Tech provided an excellent foundation, it is no match for years of experience; listening is a very important part of the job! I plan to continue to work on my progression within CSX. My initial roadmaster posting will be a fairly small territory, but I hope to move on to a larger territory, and a Roadmaster 1 position. Eventually I'm hoping to move from the field into a position with CSX where I can better use my Tech degree, but my field experience will provide an excellent background for this future work!



Irfan Rasul

AECOM, Inc.

I graduated from Michigan Tech with an MS in Civil Engineering in Summer 2014. While at Michigan Tech I conducted my Master's research under Dr. Pasi Lautala, focused on multimodal options in the Upper Peninsula of Michigan. I also participated in REAC and other rail related activities at Michigan Tech. After interning at Engineered Rail Solutions (ERS) in Illinois, I joined the transit team in AECOM's Minneapolis Offices as a Track Design Engineer. The Rail Transportation Program (RTP) at Michigan Tech provided me with the critical exposure to the railroad industry through networking and hands-on experience in design. This was instrumental in obtaining my current position and provided me with the tools to succeed. I'm currently working on a Light Rail project which will connect the southwestern suburbs of Minneapolis with the downtown areas of the twin cities. This is a unique project which requires AECOM to work with sub consultants at the client office. My job on this team is preparing track designs and developing track details. I also lead the track clearance calculations, which requires me to coordinate across different disciplines and ensure deadlines are met. I'm involved in the Graduate Development Program at AECOM which mentors young engineers to ensure a successful career in industry. I'm looking forward to being involved in all of the opportunities that AECOM has to offer!



Student Intern/Co-op Highlights



Alex Lakenen
Engineered Rail Solutions, LLC

In the spring of 2015 I was elected president of the REAC, and shortly after that I was invited to fill an intern position with Engineered Rail Solutions in Chicago. I have been a member of REAC since 2014. I spent the summer of 2015 working and living in the Chicago area. My primary duties involved developing quantity and cost take-offs for rail terminal projects, including work with New Orleans Public Belt Railroad. I also had the opportunity to attend the NURail Center annual meeting, which was held in Chicago during the summer. This gave me the opportunity to interact with students from other universities involved in railroad education which was a definite advantage as I pursued my duties as REAC president during this school year. Next summer I'm hoping to pull down an internship with one of the Class 1 railroads.



Rachel Klumpp
Canadian National Railroad

During the summer of 2015 I filled an intern position with CN that ended up being an awesome experience! I had the opportunity to shadow operations staff, including train masters, supervisors, conductors, and engineers. I also learned about some of the key computer systems used by CN for managing trains, crews, and cargo are not all user friendly! I also got to ride trains in all kinds of fun locations, from the Canadian border to New Orleans and I spent several memorable days in Ranier, MN shadowing the local trainmaster. He had time to spend one-on-one with me, and I learned a lot about train operations. I finished my summer with three days in New Orleans, learning about customers and customer relations. I also had some time for some site-seeing; Café du Monde was the best! Next summer I plan to return to CN for a follow on internship.



Otto Freiberg
HNTB

Summer of 2015 provided an awesome work experience for me! I spent the summer in Chicago working with HNTB on design projects for the Chicago Transit Agency. I spent most of my time working with Microstation and AutoCAD on railroad details and track layouts. Although it was tedious at times, the overall experience was great; working on real projects that would get implemented almost right away. It gave me a really good broad education on what goes into transit and commuter rail lines. While I was in Chicago one of my favorite activities was exploring all of the great restaurants available in the city. My favorite was the Green Street Smoked Meats; great atmosphere and some of the best barbecue anywhere! I'm hoping to return to Chicago next summer for another consultant internship in the rail industry.





Graduate Students

2014-2015 Graduates

Dr. Hamed Pouryousef, PhD

Dr. Hamed Pouryousef graduated in spring 2015 as the first Ph.D. student of the RTP under supervision of Dr. Pasi Lautala. His research focused on the application of timetable management techniques (e.g. rescheduling and timetable compression) in the U.S. rail environment and their effect on capacity utilization and level of service parameters. The title of his dissertation was “Timetable Management Technique in Railway Capacity Analysis: Development of the Hybrid Optimization of Train Schedules (HOTS) Model”.



Dr. Hamed Pouryousef and Dr. Pasi Lautala

The HOTS model can be used to complement a commercial rail simulation model (or timetable management tool) in the development of a conflict-free and compressed time-table for a given corridor. The HOTS model is a multi-objective mixed integer linear programming (MILP) model which can also be used, under certain conditions, as linear programming (LP) model. HOTS is applicable to various corridor configurations, including single, double and multiple track corridors using both directional and non-directional (bi-directional) operations patterns.

Continuing Graduate Students

Priscilla Addison

MS Candidate, Geological Engineering
Advisor: Dr. Thomas Oommen

Priscilla received her BSc. degree in Civil Engineering from Kwame Nkrumah University of Science and Technology, Ghana. She then went on to practice as an assistant civil engineer for a couple years, after which she decided to pursue graduate studies Her master’s program at Michigan Tech involves research on the Rail Embankment Stabilization Needs on the Hudson Bay Railway, funded collaboratively by the NURail and Omnitrax.

Hanieh Deilamsalehy

PhD Candidate, Electrical Engineering
Advisor: Dr. Timothy Havens

Hanieh Deilamsalehy received her B.Sc. and MS degree in Tehran, Iran in Electrical Engineering and became familiar with Image Processing and Machine Learning methods during her masters program. After beginning her PhD at Michigan Technological University she was introduced to the rail program at Tech and decided to use those methods to implement an automated method for railway wheel defect detection.

Maryam Fakhrosseini

PhD Candidate, Applied Cognitive Science & Human Factors
Advisor: Dr. Myoungsoon Philart Jeon

Maryam received her B.S. in Clinical Psychology and her MS in General Psychology in Tehran, Iran. During her

graduate studies, Maryam studied applied cognitive science. In the Michigan Tech Rail program she has been responsible for investigating topics related to driving safety and human factors including visual warning displays at grade level crossings.

Sumanth Kalluri

MS Candidate, Civil Engineering
Advisor: Dr. Pasi Lautala

After completing his Bachelor’s in Civil engineering from Vijayawada, India, Sumanth applied to the Michigan Tech Masters in Civil Engineering program, after learning about the RTP. In his MS project, he’s currently working on Comparative Life-Cycle Assessment (LCA) and Life-Cycle Cost Analysis (LCCA) of Road, Rail and Multi Modal Freight Transportation and implementing it through a case study of the Copperwood Project

Sanpil Ko

PhD Candidate, Civil Engineering
Advisor: Dr. Pasi Lautala

Sangpil received his B.Sc. and MS degree in Seoul, South Korea and majored in the department of Transportation and Logistics. He worked at Korea Railroad Corporation (KORAIL) after graduation. This experience lead him to pursue additional studies in transportation and railroad research. Sangpil is currently working with the PIRE Biomass project, funded by NSF.

Steve Landry

PhD Candidate, Applied Cognitive Science & Human Factors
Advisor: Dr. Myoungsoon Philart Jeon

Steven received his BA in psychology from Southeastern Louisiana University and then worked at Louisiana State University’s Visual Cognition Lab under the supervision of Dr. Melissa Beck. From there he was accepted into the PhD program at Michigan Technological University studying Applied Cognitive Science and Human Factors, with a focus on auditory displays and data sonification. Steven is a working on “Project Train Sounds; Getting Active with Passive Crossings” to improve compliance and safety for drivers at railway crossings, funded by NURail.

Karl Warsinski

PhD Candidate, Materials Science & Engineering
Advisor: Dr. Paul Sanders

Karl earned B.S. degrees in both Materials Science and Engineering and Civil Engineering at Michigan Tech before continuing to graduate school to focus on metal casting. His early graduate work ranged from heavy section ductile iron casting to production of Ductile Iron from high purity components. Karl is currently working on “Austempered Ductile Iron (ADI) for Railroad Wheels”, funded by NURail. His Ph.D. thesis concentrates on the stability of the ausferrite microstructure under elevated service temperatures like those experienced by railroad wheels during on-tread braking.

Graduate Student Research Highlights

Priscilla Addison

Rail Embankment Stabilization Needs on the Hudson Bay Railway

The Hudson Bay Railway (HBR) is a 510-mile railway built within the permafrost region of Northern Manitoba, Canada. Permafrost was first encountered during its construction at milepost 136 in isolated peat bogs which continued in a gradual northward transition from discontinuous to continuous permafrost. Over the past eight decades, warming climate combined with poor engineering properties of the railway embankment material has resulted in thawing of the permafrost leading to differential settlements (termed ‘sinkholes’) and high annual maintenance costs.

Researchers at Michigan Tech were tasked to investigate the current condition of the HBR and identify contributing factors to the permafrost decay, develop a rating scheme that classifies the different severities of the sinkhole affected areas along the HBR, and investigate corrective measures to address the different severity ratings.

Geophysical exploration techniques like ground penetrating radar (GPR) and electrical resistivity tomography (ERT) were combined with satellite remote sensing techniques to investigate the current permafrost condition. This analysis revealed that earlier defined permafrost zone classifications along the route were changing. Permafrost degradation seems to be moving northwards as previously stable permafrost tables in the discontinuous zones were seen to be thawed. Also, the southern boundary of the continuous zone now has discontinuous permafrost in its extent.

A regression model has been developed utilizing track geometry and remote sensing data that classifies the different severities along the route. This showed vegetation and surface water to be good predictors of the underlying permafrost condition. Finally, different permafrost stabilization solutions were evaluated for different degradation severities and conceptual level costs were developed for installation and maintenance. The research was made possible by the financial support of OmniTRAX Inc. and National University Rail (NURail) Center funded by the U.S Department of Transportation, Research and Innovative Technology Administration (USDOT-RITA).

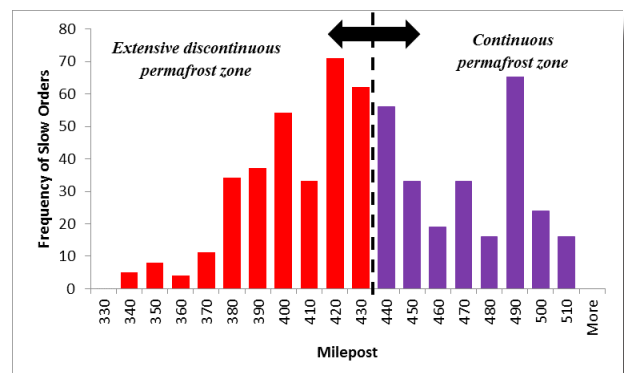
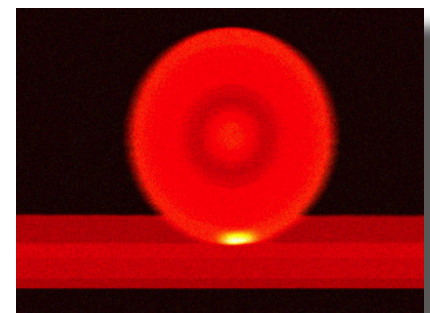
Hanieh Deilamsalehy

Automatic Method for Detecting Sliding Railway Wheels and Hot Bearings Using Thermal Imagery

One of the most important safety-related tasks in rail industry is an early detection of defective rolling stock components. Railway wheels and wheel bearings are two components prone to damage due to their interactions with brakes and railway track, which makes them a high priority when the rail industry investigates improvements to current detection processes. One of the specific wheel defects is a flat wheel, which is often caused by sliding during a heavy braking application. The main contribution of the research done by Hanieh is development of a computer vision method for automatically detecting the sliding wheels from images taken by wayside thermal cameras. As a byproduct, the process will also include a method for detecting hot bearings from the same images.

In this research, first an automatic detection and segmentation method was used to identify the wheel and bearing portion of the image. Then, a method is developed, using “Histogram of Oriented Gradients” to extract features of these regions. These feature descriptors are later employed by “Support Vector Machine” to build a fast classifier with a good detection rate, which can detect abnormalities in the wheel. At the end, the algorithm was trained using simulated images of sliding wheels and was tested on several thermal images collected in a revenue service by the Union Pacific Railroad (UPRR).

Using thermal imagery (right) to detect sliding railway wheels and (below) evaluating slow orders at different mileposts along HBR railway





Student Activities & Scholarships



Conceived in 2005, REAC became the first student chapter of the American Railway Engineering and Maintenance of Way Association (AREMA). Attracting students from multiple disciplines and providing opportunities to explore career options in the rail industry, REAC has become a networking powerhouse within the Michigan Tech campus community.

This past year has been really exciting for REAC and all of the students and industry involved. Aside from the monthly General Business Meetings, the group is highly active in organizing social gatherings, community outreach opportunities, field trips, and special events throughout the year. In fact, in fall 2014, REAC and RTP presented the 1st Annual Rail Day & Expo in conjunction with our Annual Rail Night. This event provided an opportunity for rail industry representatives to showcase the career opportunities available across the industry. The day was highlighted by industry displays and demonstrations, and featured a “meet the industry” panel discussion. This event allowed students, faculty, and administration to learn more about rail transportation and to speak one on one with railroad industry representatives.

Aside from connecting students to the industry, another goal of REAC is to increase our visibility on campus. In September of last year, REAC students held a booth at the Michigan Tech student involvement fair (K-Day) featuring games and information about the club. This event gave the campus-wide student body an opportunity to learn more about REAC and what we do. Speaking of what we do, REAC has been heavily involved in the local community surrounding Michigan Tech. In October, students from REAC volunteered at the Lake Linden & Torch Lake Railroad Museum. They helped to lay down ties, spikes, and rail on a newly installed causeway that was once an old, wooden trestle. Also, REAC has made plans in the future to assist the Quincy Mine Hoist & Museum with repairs to their cog railway, pending inspection.

As we turn the pages to another year, REAC aims to continuously increase our reputation as an excellent opportunity for students to become involved and discover the many different possibilities the rail industry has to offer. Plans are already being made for Rail Night XI & 2nd Annual Rail Day & Expo, and students are excited to attend Railway Interchange 2015 in Minneapolis this fall. REAC continues to build upon its foundation and looks forward to spreading the word about rail industry opportunities in the year to come.

Alex Lakenen, REAC President

REAC Students Travel to Omaha, NE to tour UPRR Headquarters

March 26 - 29, 2015

The Railroad Engineering and Activities Club (REAC) took 15 members to Omaha, NE to visit Union Pacific Headquarters. UP hosted the stay, and provided tours of the Headquarters, the Harriman Dispatch Center, and the Council Bluffs Railyard. UP also provided a tour of the Heritage Fleet cars, and dinner on the Heritage Fleet dining car.

Students were amazed at the opulence provided to passengers on some of these cars- spacious accommodations, some with sitting rooms as well as sleeping rooms with queen size beds! The wood work in the cars was absolutely stunning. Greg “Bubba” Garrison was our host for the dinner; salmon and steak that the group raved about the rest of the trip! The Harriman Dispatch Center was another favorite of the group, they were amazed at the technology involved and the amount of traffic controlled from this single control center.



Saturday’s focus was the Council Bluffs yard. After lunch, hosted by UP at Tish’s, near the yard entrance, the students headed into the yard. What started as a planned one hour tour ended up taking the entire afternoon. Students got to see all facets of the yard operation, and peppered Ryan, the tour guide, with questions. The day’s formal activities concluded with a tour of the Omaha Public Power District power plant, a coal fired plant served by UP trains.

Rail Transportation Program Congratulates Scholarship Winners

Each year the RTP offers internal scholarships funded by industry partners and students compete for AREMA scholarships.

AREMA Scholarships

Derek Owen	Michigan Tech Alumni Scholarship
Christopher L. Blessing	John J. Cunningham Memorial Scholarship
Michael Larson	AREMA Committee 27- Maintenance-of-Way Work Equipment Scholarship
Sean P. Pengelly	AREMA Committee 14- Yards & Terminals Scholarship
Tanja S. Mattonen	Michigan Tech Alumni Scholarship

Michigan Tech Rail Industry Scholarships

Christopher L. Blessing	Union Pacific Scholarship
Michael Larson	CN Scholarship
Antonio Passariello	CN Scholarship

10th Annual Rail Night & 1st Annual Rail Day Expo a Success

October 14, 2014

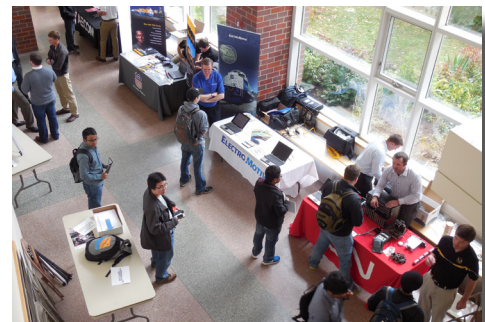
The Michigan Tech Rail Transportation Program (RTP) and Railroad Engineering and Activities Club (REAC) organized what turned out to be an awesome day of railroad industry activities on the Michigan Tech campus. The 22 companies involved with the rail industry collaborated to showcase the industry to our students, and to encourage those students to consider careers in rail. The day opened with several events for our industry guests: a welcome and overview from the RTP director, Dr. Pasi Lautala; and a student poster session and breakfast. The poster session demonstrated the depth and breadth of our undergraduate and graduate student projects and research programs to our guests.

In the afternoon students had the opportunity to visit industry displays and talk with industry representatives. Career opportunities, rail technology, equipment, and jobs were all topics of discussion. The Dow courtyard was filled with railroad equipment, and a tent that offered free lunch to students at the price of a visit to an industry display. The day continued with a *Meet the Industry Session*, attended by over 50 students. Industry representatives talked about their companies and discussed career opportunities for all disciplines. A question and answer period provided additional information to students, and industry provided door prizes that kept everyone interested!

Our 10th Annual Railroad Night with over 140 attendees, including industry, faculty, students, and local community members rounded out the evening. The social period gave our students a chance to wrap up discussions from the day in a relaxed setting. Presentations by Mr. Bruce Seely and our keynote speaker, Mr. Tim Hoeffner, provided the background to a stimulating evening of conversation.



-Keynote Speaker-
Tim Hoeffner, Director,
Office of Rail, MDOT



Rail Day Exhibitors & Students



Youth Activity Highlights

Attracting and educating K-12 students in rail (and other) transportation sectors is a top priority for the RTP. In 2014-2015, RTP led and contributed to the following activities to accomplish that mission.

Boy Scouts Railroading Merit Badge Event

On April 11, REAC sponsored a merit badge course for local scouts. Austin Smith headed up a class for boy scouts to attain their Railroading merit badge, assisted by Kelsey Abbott. The Lake Linden and Torch Lake Railroad and Houghton County Historical Museum hosted five scouts, and provided materials to assist in the program. All of those who attended had a great time. Lunch was provided by RTP.

Spring Break Camp (Grades 4-6)

Aaron Dean and David Nelson lead a session for elementary school students in support of the Michigan Tech Spring Break Science Camp. Students learned about Operation Lifesaver and rail safety, explored the world of magnetic levitation and it's applications to railroading, and tried their hand at sorting rail cars with an on-line shunting game.



Students Explore Magnetic Levitation during Spring Break Camp

Student & Youth Other Events

July

July 8, 2014-
Engineering Scholars Program Presentation
Pasi gave an invited presentation to over 100 top high school students participating in the Michigan Tech's ESP program.

July 9, 2014-
ESP Expo Day
Dave Nelson and Tech Students Manned booth with REAC and RTP information, discussed opportunities in the rail industry with visiting high school students.

July 27, 2014-
5th Annual Summer Youth Program in Rail & Intermodal Transportation

October

October 11, 2014-
Lake Linden & Torch Lake RR Track Construction
Five REAC members helped lay down ties, spikes, and rail on a newly installed causeway that was once a wooden trestle.

February

February 17, 2015-
Spring Career Fair & Rail Info Night
In conjunction with the fall career fair, REAC was able to have several rail industry companies give short speeches about their company and answer students questions

March

March 5, 2015-
Presentation for Joan Chadde
Dave Nelson gave a short presentation on Transportation Careers for High School Teacher TRAC workshop

May

May 7-8, 2015-
Construction Career Days
Dave Nelson supported a Civil Engineering booth at Construction Career Days in Howell, MI

July

July 23, 2015-
NSTI Transportation Presentation
Pasi Lautala participated in Q&A session related to Extreme Railway documentary and discussed rail transportation with NSTI participants

July 23, 2015-
Teacher Institute Presentation
'Designing a Sustainable Future' Pasi Lautala provided lessons in transportation and railways for the teacher institute

July 26-31, 2015-
6th Annual Rail & Intermodal Transportation Summer Youth Program
See Article on Page 17



Dave Nelson (left) and Aaron Dean (right) represented both REAC and RTP and spoke with students about rail education during the Engineering Scholars Program Expo Day

6th Annual Rail & Intermodal Transportation Summer Youth Program

July 26 - July 31, 2015

The 6th Annual Summer Youth Program in Rail and Intermodal Transportation, presented by the Michigan Tech Rail Transportation Program, was held July 26-31, 2015. The event consisted of an awesome week of field trips and hands-on activities centered on the rail industry and it's connections with other transportation modes. The program attracted a record number of youth with 23 students in attendance. This year, along with a valuable classroom learning environment, the student activities included field trips to LS&I railroad in Ishpeming, MI, BNSF railyards and Halvorson trucking in Superior, WI, and the CN ore docks and Duluth Railroad Museum in Duluth, MN.

Editor's Note: *The article for SYP 2014 was included in the 2013-2014 Annual Report. To view that report, visit rail.mtu.edu, then click on Resources → Annual Reports*

2015 SYP Program Sponsors:



Visit to CN Ore Dock in Duluth, MN



Students Explore Track Components



Students Operate a Simulator



Visit to BNSF Car Shop in Superior, WI



Professional Development at Michigan Tech

Publications/Conferences

Journal Publications

Pouryousef, H., Lautala P., Hybrid Simulation Approach for Improving Railway Capacity and Train Schedules, *Journal of Rail Transport Planning & Management* (2015), <http://dx.doi.org/10.1016/j.jrtpm.2015.10.001>

Lautala, P., Haas, P., Velat, J., HIGH SPEED RAIL LEARNING SYSTEM (HSRLS) – Taking Advantage of Online Technologies in Railway Education, *International Journal of Transportation Science and Technology* · vol. 4 · no. 2· 2015 – pages 179 – 196, July, 2015

Pasi T. Lautala, Michael R. Hilliard, Erin Webb, Ingrid Busch, J. Richard Hess, Mohammad S. Roni, Jorge Hilbert, Robert M. Handler, Roger Bittencourt, Amir Valente, Tuuli Laitinen Opportunities and Challenges in the Design and Analysis of Biomass Supply Chains, *Environmental Management*, July, 2015.

Pouryousef, H, Lautala, P., White, T.; Railroad Capacity Tools and Methodologies in the U.S. and Europe; *Journal of Modern Transportation*, (2015) 23(1):30–42

Abbas, Dalia, Robert Handler, Bruce Hartsough, Dennis Dykstra, Pasi Lautala, and Larry Hembroff. "A Survey Analysis of Forest Harvesting and Transportation Operations in Michigan." *Croatian Journal of Forest Engineering* 35, no. 2 (2014): 179-192.

Conference Papers / Presentations

Addison, P., Baeckerfoot, J., Oommen T., Lautala P., Koff K., and Vallos Z. (2015) Rail embankment investigation using remote sensing for a permafrost region, ASCE International Conference on Cold Regions Engineering. Salt Lake City, UT, July 19-22, 2015

Addison, P., Oommen T., Lautala P., Review Of Past Geotechnical Performance Of The Hudson Bay Rail Embankment And Its Comparison To The Current Condition, ASME/ASCE/IEEE 2015 Joint Rail Conference, San Jose, CA, March 23-26, 2015.

Fakhrhosseini, S.M., Jeon, M., Lautala, P., Nelson, D., An Investigation On Driver Behaviors And Eye- Movement Patterns At Grade Crossings Using A Driving Simulator, ASME/ASCE/IEEE 2015 Joint Rail Conference, San Jose, CA, March 23-26, 2015.

Pouryousef, H, Lautala, P.; Capacity Evaluation of Directional and Non-directional Operational Scenarios along a Multiple-track U.S. Corridor; Transportation Research Board 94th Annual Meeting of the National Academies, Washington, DC, January 11-15, 2015

Hardy, A, Hill, J., Jeon M., and Lautala, P, Driver Response to Grade Crossings and the Effects of Different Warning Types, 2014 Global Level Crossing Safety & Trespass Prevention Symposium, Urbana, IL, August 3 - 8, 2014

Conference / Invited Presentations

March 23-26, 2015- Pouryousef, H, Lautala, P., Applying a New Rescheduling Model (HOTS) to Improve the Capacity of a Single Track Shared-use Corridor, ASME/ASCE/IEEE 2015 Joint Rail Conference, San Jose, CA

December 10-11, 2014- Lautala, P., Multimodal Opportunities to Reduce the Effects of Changing Fuel Prices - Case Studies of Upper Midwest Forest Products Industry, 8th University Transportation Center Spotlight Conference on the Role of Freight Transportation in Economic Competitiveness, Washington, DC

Nov. 12, 2014- Lautala, P., "Railroad Careers And Programs" Department of Civil Engineering, Oregon State University

November 9-12, 2014- Pouryousef, H, Lautala, P.; Hybrid Simulation Approach for Rail Shared Corridor Capacity Analysis; INFORMS 2014 Annual Conference, San Francisco, CA

November 7, 2014- Lautala, P., "UP Michigan Rail Study", Northwood Transit Commission, Rhinelander, WI

October 23, 2014- Lautala, P., "Freight (Rail) Transportation in the State of Michigan & at Michigan Tech", Western Lake Superior Area Maritime Security Committee - "Eastern Sector" & UP Port Area Committee

August 26-27, 2014- Lautala P., University Railroad Engineering Education, 2nd Annual Michigan Rail Conference, Warren, MI

August 26-27, 2014- Lautala P., The Upper Peninsula Freight Rail Study, 2nd Annual Michigan Rail Conference, Warren, MI

RTP in the Press

September, 2015- The 3rd Annual Michigan Rail Conference was featured in the September Issue of *ON TRACK: The E-Bulletin of the Michigan Association of Railroad Passengers*

July 28, 2015- Students from RTP's Summer Youth Program in Rail & Intermodal Transportation featured in local evening news, "Michigan Students Visit to Explore Rail Industry". *Fox News 21 Twin Ports*, Superior, WI.

May, 2015- Michigan Tech students Intelligent Jumper Cables Project was featured on Page 19 in the May issue of *Trains Magazine*

March 20, 2015- Pasi Lautala's interview, "Freight Rail is still the King in the U.S.", aired on *Marketplace of National Public Radio*

February 13, 2015- Dave Nelson and Steve Landry were quoted in the article "Despite Drop in Collisions, Intersection of Roads and Rails Still a Dangerous Place" on *Trains On-line Newswire*

February 5, 2015- Pasi Lautala quoted in the article, "Human Behavior and Physics Hamper Rail Safety Systems" *New York Times*

January, 2015- Pasi Lautala's UP Freight study article was published on Page 7 of *UP Business Today*

January, 2015- Tim Havens article on UAV Research, "Nuts, Trains, & Drones", highlighted on Page 20 in the January Issue of *Trains Magazine*

November, 2014- REAC Members Kelsey Abbott, Dylan Anderson, Chris Blessing were interviewed for the article, "Railroaders: The Next Generation", featured on Page 68-69 in the November Issue of *Trains Magazine*



SYP Students Featured in Local Evening News, Superior, WI



Priscilla Addison won *Best Paper Award* for ASCE Cold Regions Conference



Conference Highlights

2nd Annual Michigan Rail Conference

August 26-27, 2014

The Michigan Tech Rail Transportation Program (RTP) and Michigan Department of Transportation, Office of Rail organized and conducted the 2nd Annual Michigan Rail Conference at Macomb Community College, Warren, Michigan on August 26 and 27, 2014. The conference was memorable for a number of reasons. First, the program was excellent from the morning plenary sessions focused on education and work force development and collaborative partnerships through the afternoon breakouts with their passenger and freight themes. The speakers were outstanding, and the conversation stimulating.

And then there was the great power outage; midway through the afternoon the entire campus went dark. But our speakers soldiered on! Utilizing the emergency lighting system to provide some background our afternoon speakers discussed their topics in a closer setting, with no audiovisual support. The crowd thinned a bit, but the conversation continued. Following the afternoon breakouts our Keynote speaker, Tony Hatch, discussed the Railroad Renaissance in the New Energy World to a still lively crowd. With no power for preparing dinner, the conference center staff ordered in pizza, and we capped the day's events with a pizza party! The field trip on the 27th went off without a hitch touring a variety of passenger and freight facilities in the Detroit Metro area.



One of the many panel discussions that took place at the 2nd Annual Michigan Rail Conference

3rd Annual Michigan Rail Conference

August 19-20, 2015

The 3rd Annual Michigan Rail Conference took place on August 19-20, 2015 at the Grand Valley State University, Grand Rapids. The Conference broke earlier participant records with over 150 total registrations and 16 conference sponsors. The conference was co-organized by Michigan Tech's Rail Transportation Program (RTP), National University Rail Center (NURail) and Michigan Department of Transportation, under guidance from Conference Planning Committee.

The conference featured Mr. Joe Szabo (Executive Director of Chicago Metropolitan Agency for Planning, and past Administrator for the Federal Railway Administration) as a keynote speaker and included more than thirty presenters from the rail industry and other stakeholder groups. The plenary sessions covered general transportation challenges and safety issues at grade crossings and afternoon breakout sessions ranged from rolling stock (passenger and freight) discussions to a rail shipper panel and sessions on passenger rail development.

Over 70 conference participants came to Grand Rapids early for field visits that included two grade crossing improvement projects, the SteelPro Grand Rapids Steel Distribution Center, the Grand Elk Railroad transload terminal and the Grand Rapids Amtrak station.



Field trip to a grade crossing improvement site during the 3rd Annual Michigan Rail Conference

p-REES

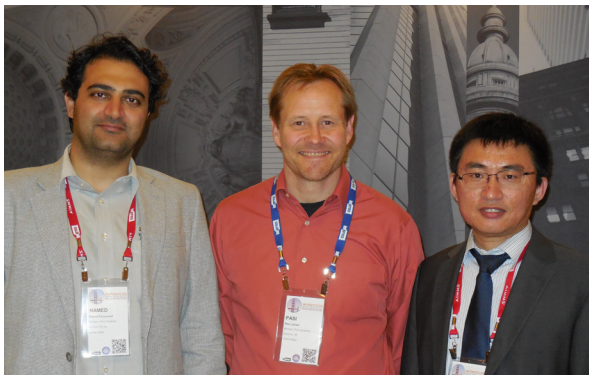
July 8-10, 2015

As ridership on public transit systems is at its highest level in sixty years, communities across the country are exploring and funding exciting new rail and transit options. To encourage more rail and transit content in engineering programs, the American Public Transportation Association (APTA), in conjunction with the American Railway Engineering and Maintenance-of-Way Association (AREMA), sponsored the Passenger Railway Engineering Education Symposium (p-REES), July 8-10, 2015 in Philadelphia, PA. The symposium provided a program for over thirty engineering faculty members from universities across Canada and the United States to meet rail and transit professionals, hear presentations on the industry and course materials, discuss faculty research, and learn about the opportunities for new graduates entering the rail and public transit profession. Field visits to the Southeastern Pennsylvania (Philadelphia) Transportation Authority (SEPTA) Operations Center and projects were also an important part of the program. Bill Sproule represented Michigan Tech at the symposium and shared his experiences in rail and public transit and provided insights on how we have developed our Rail Transportation Program and engaged students, faculty and industry on the Michigan Tech campus.

Informs

November 9-12, 2014

Pasi Lautala, Hamed Pouryousef and Kuilin Zhang attended the Inform's Annual Meeting in San Francisco. Hamed Pouryousef made a presentation "Capacity Evaluation along Baltimore-DC Based on Directional vs. Non-directional Scenarios of Operation" and Kuilin, Hamed and Pasi all participated in the meetings and dinner by the Railway Applications Section (RAS).



(Left to Right): Hamed Pouryousef, Pasi Lautala and Kuilin Zhang in Inform's Annual Conference

Guest Speakers / Visitors

September

September 9, 2014-
Pauli Kolisoja, Tampere University of Technology
Rail Research and Railroading in Finland

October

October 14, 2014-
Tim Hoeffner, Director, Office of Rail, MDOT
-Rail Night Keynote Speaker

November

November 4, 2014-
Greg Garrison, Vice President, UPRR North Region
Upcoming Winter Challenges

December

December 4, 2014-
Dave Nelson, REAC Advisor
Rail Access to Arcadia National Park?

January

January 22 4, 2015-
Art Menard, E&LS Railroad
E&LS Car Repair Shop

February

February 12, 2015-
John Rickoff, Lake State Railway
Future of Shortline Railroads

February 27, 2015-
Brent Wilson, Amsted RPS
Railroad bearing and Wheel Failures

March

March 3, 2015-
Phil Pasterak, PB
High Speed Rail and Urban Rail Systems

March 17, 2015-
Brian Buchanan, CN Railroad
Operations and Freight Movement- Beginning to End

March 24, 2015-
Mike McHenry, TTCI
Track Materials and Geometry (Web Presentation)

March 31, 2015-
Brad Howard, NY Air Brake
Autonomous and Remote Train Operations (Web Presentation)

April

April 14, 2015-
Chris Blanton, The Andersons, Inc
Tank Car Fleet Management and the Grain Business (Web Presentation)

June

June 1-6, 2015-
Roger Bittencourt, LabTrans
Discussed future NSF collaborations with RTP

John Rickoff from Lake State Railway, gives presentation on *The Future of Short Line Railroads*





Other Events / Professional Development / Workshops

June

June 26-27, 2014-
AREMA Committee 24 Meeting
Dave attended the AREMA Committee 24 meeting in Omaha, to wrap up REES 2014. Also met with Phil Danner, Tom Bartlett, and Steve Abolafia to discuss recruiting issues.

October

October 13, 2014-
RTAB Meeting-
Six members of the RTAB gathered at Michigan Tech for the annual on-site meeting, three others participated virtually.

January

January 21-24, 2015-
AREMA Committee 24 Meeting
David Nelson attended meeting, presented update on REES programs, new responsibility for Passenger Rail chapter in PGRE revision currently in work.

June

June 3, 2015-
Visits to Forest Products Companies
Dr. Lautala, Sangpil Ko and Roger Bittencourt (Brazil) visited three forest products industry companies to discuss transportation logistics.

August

August 4-7, 2014-
Grade Level Crossing Symposium 2014
Dave Nelson and Myoungsoon (Philart) Jeon attended GLXS 2014, Philart presented findings on Grade Crossing Research

August 17-22, 2014-
2014 Annual NURail Meeting & TRB Summerail.

January

January 11-14, 2015-
Transportation Research Board Meeting
Pasi Lautala and Hamed Pouryousef- Hamed presentation Capacity Evaluation Of Directional And Non-directional Operational Scenarios Along A Multiple-track U.S. Corridor. Pasi moderated a session 424 - The Future of Domestic Intermodal Transportation.

April

April 9, 2015-
Commission for Logistics & Supply Chain Collaboration, Lansing MI
Pasi Lautala Attended

April 16, 2015-
Senior Design Presentation to CEEPAC on Wayne Industries Site Development Project
Dave Nelson, Bill Leder and senior design team

June

June 4-6, 2015-
NURail Annual Meeting
Pasi Lautala, David Nelson, attended Hamed Pouryousef the annual NURail meeting in Chicago, hosted by UIC. Dave and Pasi collaborated on a presentation about undergraduate research projects at Michigan Tech.

November

November 5-11, 2014-
Highway-Rail Grade Crossing Safety Course
Dave attended.

May

May 5, 2015-
Visit to Lake State Railway
Dave Nelson

May 6-7, 2015-
Continuing Education Seminar
Pasi Lautala participated in the seminar at UW-Madison

June 3, 2015-
Presentation to Engineering Society of Detroit
Pasi Lautala and Dave Nelson gave a presentation to The Engineering Society of Detroit (ESD) Executive Director Robert Magee and other ESD staff

September

September 27-30, 2014-
AREMA Annual Meeting
Pasi Lautala and 15 students attended the 2014 AREMA Annual Conference in Chicago.

January 15, 2015-
Midwest Association of Rail Shippers Annual Meeting & Wisconsin Central Group Advisory Board Meeting, Oakbrook, IL
Lautala Participated in both MARS and WCG meetings.

January 16, 2015-
Commission for Logistics & Supply Chain Collaboration, Lansing MI
Pasi Lautala Attended

May 8, 2015-
MDOT Research Summit
Dr. Lautala was invited expert on MDOT's research summit

July

July 9, 2015-
Commission for Logistics & Supply Chain Collaboration, Lansing MI
Pasi Lautala Attended

National University Transportation Center

In 2012, the seven university consortium, including Michigan Tech, was awarded the first National University Rail Transportation Center (NURail) by the USDOT Research and Innovative Technology Administration (RITA). After 2013 competition, NURail also became a Tier-1 University Transportation Center.

The primary objective of the NURail Center is to improve and expand rail education, research, workforce development, and technology transfer in the U.S. The grant has supported various educational and student activities and projects covered in this report and there are five on-going NURail research projects at Michigan Tech. Many of the projects receive (have received) complimentary funding from non-federal sources.



NURail Researchers



Tim Havens
Assistant Professor,
Dept. of Electrical & Computer Engineering



Thomas Oommen
Assistant Professor,
Dept. of Geological Engineering



Dr. Paul Sanders
Assistant Professor,
Dept. of Material Science & Engineering



Myoungsoon Jeon
Assistant Professor,
Dept. of Cognitive & Learning Sciences



Pasi Lautala
Assistant Professor,
Civil & Environmental Engineering

NURail

Ongoing NURail Projects

Computer Vision and Machine Learning Method for Detection and Assessment of Wheel Anomalies Using Sensor Fusion of Thermal and Visible Spectrum Cameras (by Dr. Tim Havens); We proposed a machine learning approach that automatically detects and identifies sliding wheels in thermal and visible spectrum imagery. In this work, we first detect and extract the wheel and bearing region. Then we extract feature descriptors of the area of interest in order to find anomalies in the wheel. We employ the extracted features to classify the wheel into two possible categories of defective and non-defective. Once the sliding wheels are detected we will use some other features of them to estimate and report the level of damage using a fuzzy inference system. At the same time, we can find the mean temperature of the extracted bearing region to detect hot bearings if they exist.

The Effects of Auditory Warnings and Driver Distraction on Rail Crossing Safety (by Dr. “Philart” Jeon); Replication of the previous visual warning study found that both active warnings and passive warnings do not necessarily make drivers look wider (i.e., check their left and right as originally intended) when they approach rail crossings. Currently, we are looking at how different auditory cues can induce different behaviors at rail-crossings. We designed 32 auditory warning signals and evaluated them in terms of critical auditory display elements: overall, urgency, annoyance, startle, natural-in-car, meaning, and discriminability with 27 participants. Earcons were preferred overall, but still annoying and startling. Human voices were preferred over synthetic voices and female voices were rated more natural, urgent, and annoying compared to male voices. Principal Component Analysis showed that these elements can be grouped as two factors: Utility and Impulsivity. Based on this result, we are conducting an auditory warning experiment to investigate actual effects of the selected sounds at simulated rail crossings.

Rail Embankment Stabilization for Cold Climate Railroads – Case of Hudson Bay Railway (by Dr. Thomas Oommen); The focus of the research project for this reporting period was to integrate all acquired surficial data to develop a severity rating scheme that characterizes the different problem sections found along the rail corridor. In order to accomplish this, a probabilistic model was built with surface vegetation and water indicators obtained from remote sensing to predict locations with recorded track geometry defects. Results obtained from this model were then compared with surface roughness values extracted from track geometry data to define three severity levels along the HBR: low, moderate, high.

Rescheduling/ Timetable Optimization of Trains along the U.S. Shared-use Corridors (by Dr. Pasi Lautala); The “Hybrid Optimization of Train Schedule” (HOTS) model was tested and applied for different case studies such as Washington DC-Baltimore and Detroit-Jackson segments for different scenarios and conditions.

Alloy Design and Testing of Austempered Ductile Iron for Rail Wheels (by Dr. Paul Sanders); Our current focus is thermodynamic stabilization of austenite by alloying. An initial trial pour was conducted in February. Several of the test bars were heat treated, and the microstructures were analyzed using image analysis software. DSC samples were extracted and tested to compare with prior samples. Further refinement of thermodynamic modelling is ongoing in preparation for additional pours, which are expected to take place this summer. A new sample pattern has been developed to make heat treatment and sample machining easier.

Integrated Life Cycle Assessment (LCA) and Life Cycle Cost Analysis of Multi Modal Freight Transportation Alternatives to Copperwood Project (by Dr. Pasi Lautala); Completed literature review on the past projects involving life cycle studies to compare different transportation alternatives. The important tasks and items were identified from previous studies and a list of parameters on data required for analysis was prepared. The parameter list was then shortened and made more specific to the project and was sent to Highland Copper and its associates to collect data on different tasks related to different alternatives in the project. The data was collected for most of the items. With the help of available data, we started to prepare assemblies for LCA process in SimaPro.

Cross-Infrastructure Learnings for Alternative Bridge System Designs – A Case Study on the Hybrid Composite Bridge System (by Dr. Devin Harris, Univ. of Virginia); This project concluded the technical activities in December 2014. Since the completion of the project, researchers have focused efforts on final reporting and result dissemination

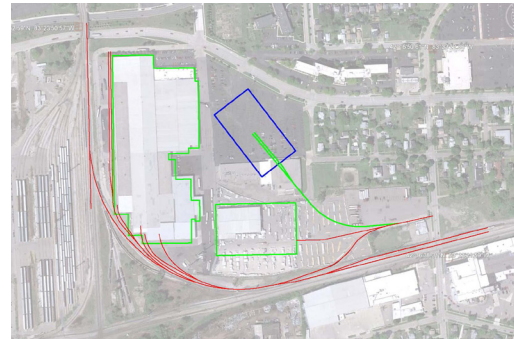


NURail Student Projects

RTP supported three undergraduate senior design and Enterprise projects with a combination of NURail and industry funding. The projects included students from civil, environmental, and electrical engineering, and for the first time students in chemical engineering. The projects and corresponding industry co-sponsors included:

Wayne Industries Site Expansion (CE)

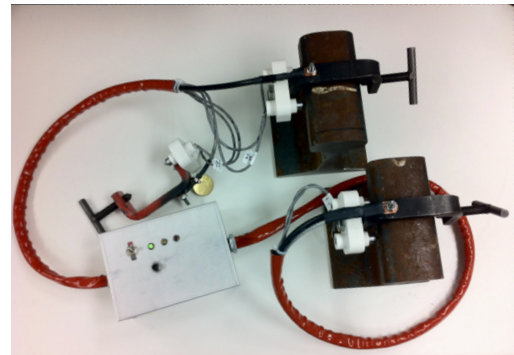
A group of civil and environmental engineering students worked with Wayne Industries to plan a site expansion for a rail served warehouse. The warehouse receives steel and aluminum by rail, and distributes those materials to the surrounding region by truck. The project involved developing a location plan and preliminary drawings for a 150,000 square foot expansion, plan and profile drawings for rail access to the new expansion, and truck access and parking for the expanded operation.



Preferred track/building layout alternative for Wayne Industries expansion

System to Measure Effectiveness of Rail Shunt (ECE)

In the rail industry, a shunt merely consists of C-clamps and low resistance wire. This is made in order to simulate the conditions of the track while a train is passing over it as the axles create a very low resistance connection across the tracks which enable various protocols to take place. However, in the simplicity of the design there is a lack of assurance that the shunt is effective in recreating these conditions posing potential threats to calibration and safety of rail workers and equipment. This team developed a clamp system and simple readout that establishes a good shunt and verifies that the shunt operation is being performed adequately.



Shunt device with three-level effectiveness display

Boxcar Insulation Design (ME, CHE)

The Consumer Product Manufacturing (CPM) Enterprise team prepared a design and performance analysis for a passive insulation package that could be easily retrofitted in a standard box car to provide limited temperature protection for perishable cargoes. Ongoing work may include developing a prototype for installation and testing.



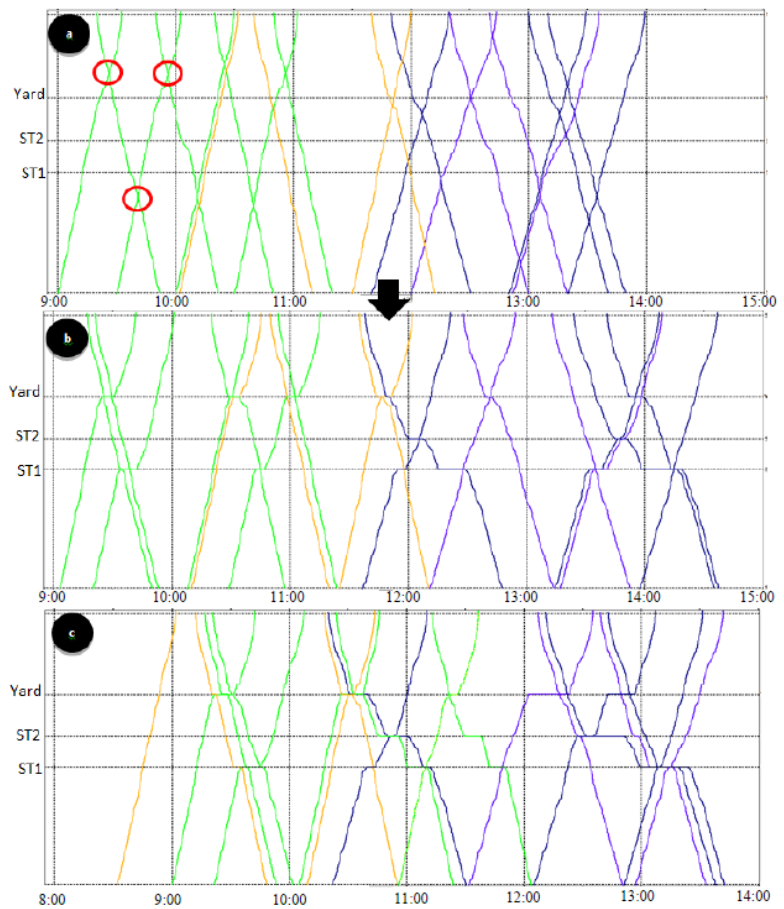
Boxcar used for dimensions of passive insulation development

Research Highlights

Development of the Hybrid Optimization of Train Schedules (HOTS) Model

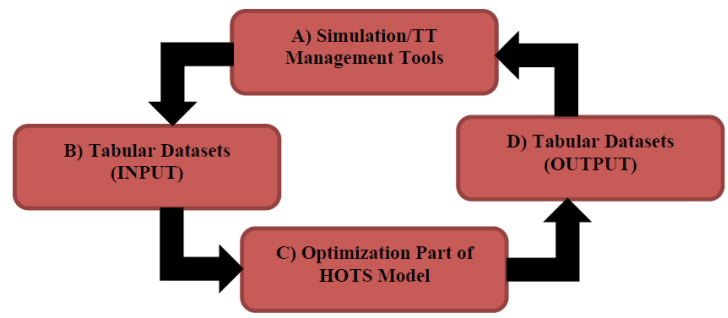
In spring 2015, Hamed Pouryousef (now Dr. Pouryousef) became the first RTP student to graduate with a Doctorate degree. Hamed’s dissertation research work concentrated on railway capacity, especially on an application of timetable (TT) management techniques (e.g. rescheduling and timetable compression techniques) in the U.S. rail environment and their effect on capacity utilization and level of service (LOS) parameters. As part of his research, Hamed studied extensively several commercial simulation tools from the U.S. (Rail Traffic Controller, or RTC) and Europe (RailSys and OpenTrack) and used the expertise gained toward development of his own optimization model, the Hybrid Optimization of Train Schedules, or HOTS.

HOTS is a multi-objective linear programming (LP) model for train rescheduling at strategic and tactical planning levels. It works together with existing rail simulation tools, extending their capabilities to improve the capacity utilization or the LOS of a given rail corridor by applying both conflict resolution and timetable compression techniques (see figure). HOTS is applicable to single-, double-, and multiple-track corridors (N-track network), using both directional and bi-directional operations. It also allows two alternative optimization approaches; “same-order” that maintains the train departure order and “order-free” that may re-organize departure order as part of the optimization process. An example timetable (stringline) before and after HOTS optimization with both approaches is shown in the Figure.



Stringline of a) “initial schedule” with several conflicts, b) after “same-order” optimization, and c) after “order-free” optimization

The development of HOTS was supported by National University Rail (NURail) Center, a US DOT-OST Tier 1 University Transportation Center. It was also applied extensively in a project “Evaluating the Use of Operational Management Techniques for Capacity Improvements on Shared-Use Rail Corridors”, funded by the National Center for Freight & Infrastructure Research & Education.



Main Steps of HOTS Model Operation

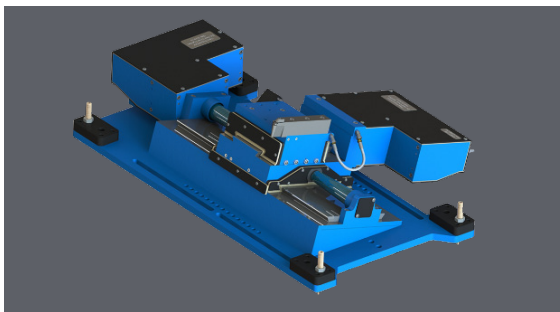


Rail Technology Development in Houghton, Michigan

Over the past year, RTP has continued its collaboration with local technology companies to expand their exposure to the rail related development and research activities. In 2013-2014 annual report we announced funding received by GS Engineering from the Small Business Innovative Research (SBIR) program organized by the U.S. Department of Transportation. GS Engineering has successfully completed the Phase I of their “Easy Access to Freight Locomotives” project in response to an unmet need for a safer and easier way for workers to access the locomotive. The device developed by the GS (see figure) automatically lifts an operators from the track ballast to deck level while allowing three points of contact at all times. GS has recently secured a contract for Phase II of the project that will refine the prototype design and install it to testing in revenue service.



Demonstration of GS Engineering “Easy Access to Locomotives” Prototype (patent pending) during the Michigan Tech Rail Day & Expo

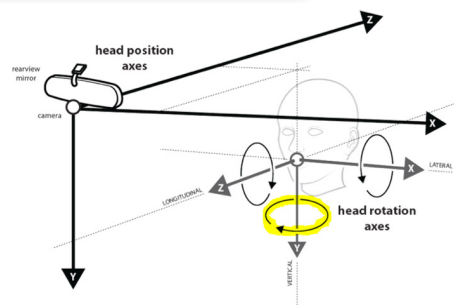


Delta Manufacturing Locomotive Wheel Lathe

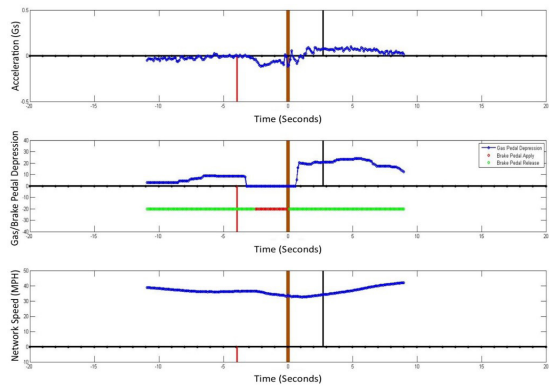
In addition to GS, Great Lakes Sound and Vibration (GLSV) has recently emerged within the rail industry as a supplier to Delta Manufacturing in Escanaba, MI. Delta has tasked GLSV with the manufacturing of several components for their Locomotive Wheel Lathes and Rail Wheel Truing equipment. Both companies share a mutual vision of delivering quality rail products that meet or exceed their customer’s requirements. This local relationship is a great step in advancing the growth of the rail industry within Michigan’s Upper Peninsula.

Driver Behavior at Highway-Rail Grade Crossings

The RTP has been involved in driver behavior studies for rail crossings for several years, but the work has taken on a new focus this year. Steve Landry has been working on a project involving in-vehicle audio cues that could help warn drivers as they approach crossings. The research covers the type of cue that will perform best as well as when to present it to the driver, with testing performed on a medium fidelity driving simulator. David Nelson and Aaron Dean have been working on a related project that utilizes data from the Strategic Highway Research Program Naturalistic Driving Study (NDS). The data comes from a study that instrumented over 3600 personal vehicles in six different regions of the country.



Michigan Tech Researchers plan to use NDS Data to Evaluate Horizontal Looking Behavior at Grade Crossings



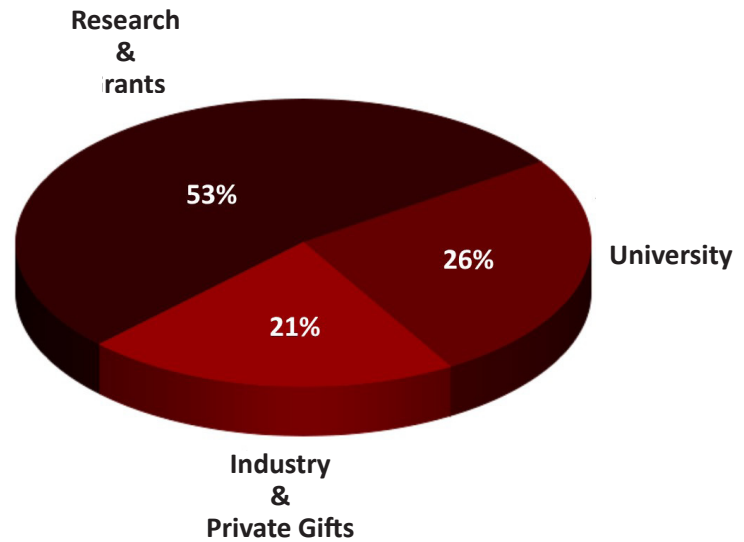
Data recorded from Vehicle Network

Participants drove their own vehicles for over a year and the study collected over 5 million trip records. The data includes throttle and brake position, speed and acceleration of the vehicle, the drivers head position and rotation, as well as forward and rear camera video and face video of the driver. The RTP work with this data was just getting started over the summer, but we plan to use the data to evaluate driver behavior in response to various types of crossing warning devices, difference between behavior of drivers who traverse a crossing frequently and those who don’t, and effects of surface conditions on driver behavior at crossings. There is the potential for many more topics within this data set!

Finances

RTP Funding

Financial support for the Rail Transportation Program is received internally at Michigan Tech from the Department of Civil and Environmental Engineering (CEE) and from the Provost. External funding consists of sponsored program research projects and contributions and gifts from industry partners and private individuals.



RTP Expenditures

Expenditures to support the rail transportation activities have been divided into several categories:

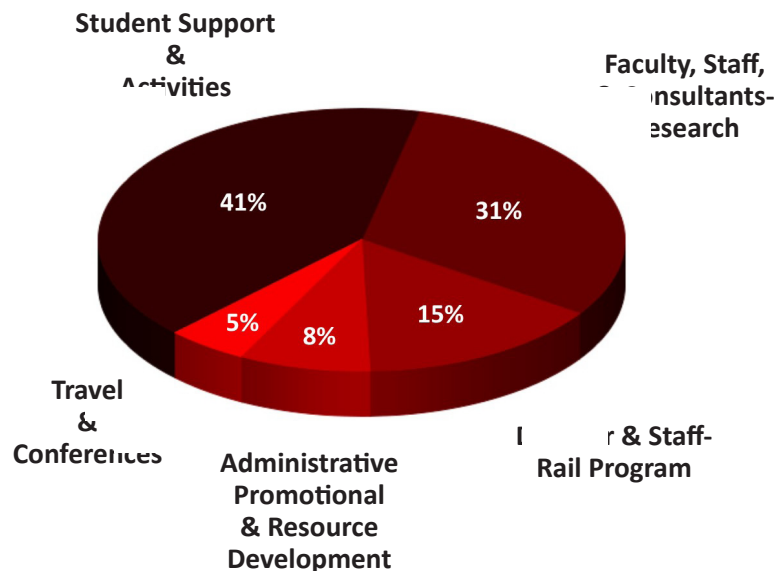
Faculty, Staff and Consultants (Research)-
Research expenses are wages, salaries, and subcontracts plus overhead charges specific to sponsored research projects.

Director and Staff (RTP)-
Rail program expenditures include director and staff salaries and other direct expenses used to support and continue development of the Rail Transportation Program.

Student Support and Activities-
Includes direct student expenses, such as tuition and stipends, expenses for conference fees and field visits, travel, and sponsorship for student events and REAC activities.

Travel and Conferences-
Includes all non-student support for travel and participation in rail and educational conferences and meetings to facilitate the development of the rail transportation program. This includes travel expenses incurred in sponsored research projects.

Administrative, Promotional, and Resource Development-
Expenses incurred in the operation and development of the rail program, such as marketing, material development, and purchase of program resources.



About the Michigan Tech Transportation Institute

The Michigan Tech Transportation Institute will provide the operating structure, resources, recognition, and leadership, in a collaborative environment, that supports research, education, and outreach leading to sustainable solutions for transportation.

MTTI is an umbrella organization bringing together the cross-disciplinary centers and principle investigators conducting transportation related research and education initiatives that address national and global needs. Principal Investigators conduct transportation research under MTTI within six transportation focused areas:

- Transportation Structures including bridges and pavements. Other related areas include geo-technical, construction, and nanotechnology related to sensors.
- Transportation Materials including concrete, asphalt, steel, wood, and aggregates. Other related areas include construction, geo technical, and nanotechnology related to sensors and materials.
- Transportation Systems including waterways, traffic/safety, construction, rail, air, public transportation, freight, intelligent transportation systems, vehicle infrastructure integration, nanotechnology related to sensors, and radio frequency identification devices.
- Environmental Aspects of Transportation includes environmental impacts, energy, carbon dioxide and other pollutants, fugitive dust, wildlife, flora and fauna, and carbon credits.
- Social Aspects of Transportation includes policy, planning, human factors, history, economics, and archeology.
- Transportation Technology Transfer includes all outreach, management systems, and workforce development programs.

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Rail Transportation Program

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Michigan Technological University is a leading public research university, conducting research, developing new technologies, and preparing students to create the future for a prosperous and sustainable world. Michigan Tech offers more than 120 undergraduate and graduate degree programs in engineering, forestry and environmental sciences, computer sciences, technology, business and economics, natural and physical sciences, arts, humanities and social sciences.



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