

EXECUTIVE SUMMARY

Mechanical and Structural Engineering leader and expert with over thirty-five years of leading-edge experience. Renowned expert and technical consultant in mechanical design, structural analysis, Finite Element Analysis (FEA), transportation safety, perimeter security, materials testing and evaluation, including failure analysis of mechanical and structural components. Strong forensic engineering expertise covering various issues and assignments, including accident reconstruction, accident causation, vehicle dynamics, safety analyses, seat belts, airbags, guardrails, crashworthiness analysis, computer simulations & animations, product failure analysis, slip and fall analysis, technical reports, and expert testimony. Selected areas of expertise:

- Mechanical Design
- Forensic Engineering / Accident Investigation
- Vehicle Crashworthiness and Transportation Safety
- Railroad Safety
- Structural Analysis
- Nonlinear Finite Element Analysis (FEA)
- Physical Security/Barrier Analysis
- Vehicle Dynamics and Vibration Analysis

PROFESSIONAL EXPERIENCE

Department of Transportation / Federal Railroad Administration (FRA) – Washington, DC **July 2011 – Present**
Mechanical Engineer / Program Manager, Office of R&D - Rolling Stock Division

Program Manager (PM) specialized in applying standard science and engineering principles, practices, criteria, and techniques to specific engineering assignments involving various factors and variables. Successfully conducted all my duties and responsibilities by applying my solid background in science and engineering principles, practices, techniques, and management to numerous R&D applied research projects. Applied my accumulated engineering, personal communication, and skills in selecting among multiple engineering alternatives to create, develop, plan, coordinate, and implement many innovative and advanced projects related to railroad safety, performance, and design improvements for the division of Equipment and Rolling Stocks and the overall area of railroad safety and performance. A shortlist of my current projects includes:

- Wheel Rolling Contact Fatigue Research – Wheel Life Model.
- University Center of Excellence (CoE) for railroad safety analysis.
- Wireless Digital Train Line Communications for Passenger Trains.
- Hazards Associated with High-Speed Rail (HSR) Operation Adjacent to Conventional Tracks.
- LED Headlight Testing for Railroad Locomotives.
- Rail Safety Training Course for Law Enforcement.
- Low Ground Clearance Vehicle Detection and Warning System.
- LIDAR Upgrade and Automated Extraction of Grade Crossing Parameters.
- Highway-Rail Grade Crossing and Trespass Prevention Research Program.
- Topology-based Freight System Resilience Evaluation and Network Improvement.
- Non-Track Circuit Train Detection for Advanced Preemption.

Advanced Research and Technology (ART), LLC – McLean, VA
Founder and Senior Consulting Engineer

2003 – Present

ART is an engineering consulting firm that performs development, design, analysis, and advanced FEA for all impact-related mechanical and structural analysis problems. Also, ART provided lots of expert-witness analysis and testimonies in the areas of Mechanical Engineering, Accident Investigation, Finite Element Analysis (FEA), transportation safety, and materials testing. ART experts have successfully conducted numerous projects for several government agencies, private industry, research institutions, attorneys, and engineering firms.

Dr. Omar's activities included:

Directed and conducted extensive design, analysis, review, and FEA for many projects in the areas of mechanical engineering, structural analysis, impact, crash, physical security barriers, and transportation safety. Some of the recently accomplished projects are:

- Analyzed numerous accident investigation/reconstruction cases, including Crash scene and vehicle inspection, calculations and analysis, personal injury, airbags and seatbelts performance analysis, FEA/computer simulations, measurement and documentation, crash report writing, technical reports, and expert testimony.
- Conducted advanced and successful crash analyses of several highway accidents involving vehicle/guardrail impacts. Our crash analysis provided major compelling evidence and assisted in solving the case for the client.
- Developed two new structural-based bollard systems (patented). These new designs provide a 40% cost savings over any other competitor's bollard system in the market.
- Reviewed and analyzed numerous structural security barriers (fixed and retractable bollards, security walls, gates, fences, wedge barriers, beams, barricades, etc.) for many renowned perimeter security providers. These extensive analyses have improved the initial design of the barriers and resulted in better performance and reduced cost.
- Analyzed and designed several highway barriers made of steel, composite, and concrete (steel guardrails, concrete barriers, sign supports, posts, etc.), resulting in better performance and less costly barriers.
- Analyzed and performed a test validation of automotive fuel tanks using advanced FEA techniques. The results provided a better understanding of and prediction regarding the fuel/structure interaction during the impact process. Also, provided recommendations regarding how to mitigate the risk of a fuel tank explosion.
- Advanced analysis and improvement of several automotive airbag systems (frontal, head-curtain, and side airbags). The analysis improved the airbag's performance and enhanced its respective safety features.
- Conducted several research projects focused on various aspects of automotive and highway safety and physical security barriers. Most of the research was carried out for the US Department of State, the US Department of Energy, the National Capital Planning Commission, and the Ford Motor Company.

George Washington University – Washington, D.C.

2002 – Present

Adjunct Professor

Taught several graduate and undergraduate engineering courses. Some of these courses include Finite Element Analysis (FEA), Stresses in Plates & Shells, Structural Analysis, Mechanical Design, Strength of Materials, Analytical Methods for Engineering, Dynamics of Particles, Solid Mechanics, and Analytical Mechanics (Static & Dynamic).

George Washington University – National Crash Analysis Center (NCAC), Ashburn, VA

1996 – 2003

Research Scientist

NCAC is a renowned research center created in 1992 as a successful collaborative effort among the FHWA, the NHTSA, and the GWU. The NCAC primarily supports the US-DOT strategic goal to reduce fatalities and injuries on the Nation's roadways and has successfully served to enhance safety worldwide.

Completed several research projects in intelligent transportation safety, vehicle crashworthiness, and highway safety. Most of the projects were done for government agencies (DOT, DOS, DOE, FHWA, and NHTSA) and private industry.

- Conducted advanced benefit analysis of the inflatable tubular structure (ITS) airbag - FEA and safety studies. The study results indicated a clear, promising potential for using ITS airbags to protect drivers and passengers from side-impact fatalities/injuries.
- Performed many FE modeling and simulations for various vehicle structures and roadside hardware.
- A comprehensive parametric study for the major simulation parameters of the non-linear FE code LS-DYNA. The study provided excellent information for researchers interested in using nonlinear FEA for analyzing and predicting vehicle crashes/impacts.
- Created and supervised a fixed-base vehicle simulator laboratory for intelligent transportation safety studies.
- Conducted advanced safety research for pre-crash driver assistance and collision avoidance for transportation safety and crash mitigation.
- Developed a special Artificial Neural Network (ANN) for modeling any vehicle's crash in frontal and offset impacts. The developed ANN successfully predicted the vehicle's acceleration curve during a collision.

- Advanced FEA research of spot-welded load-carrying rails used in motor vehicles, comparing the crush behavior and energy-absorbing capability of steel and aluminum rails. The results provided valuable recommendations for the auto industry to improve the crashworthiness of its vehicles.
- Conducted several advanced research projects focused on transportation safety, vehicle crashworthiness, and physical security protection. The research was carried out for the DOS, DOT, FAA, and private industries.

EDUCATION

Doctor of Science, Mechanical Engineering
George Washington University, Washington DC, 1999
Major: Solid Mechanics and Computer-Aided Design

Master of Science, Mechanical Engineering
Helwan University, Cairo, Egypt, 1992
Major: Structural Dynamics

Bachelor of Science, Production and Design Engineering
Menoufia University, Egypt, 1984

PROFESSIONAL AFFILIATIONS AND AWARDS

TRB Committee on Highway/Rail Grade Crossings (AHB60)
Committee Research Coordinator (CRC)

ASME Winter Annual Meeting, Transportation Safety Session
Member of the Organizing and Chairing Board since 2005

Member of the Society of Automotive Engineers (SAE) since 2002

PUBLICATIONS

In addition to more than 90 technical reports for accident investigation cases and transportation safety studies, I have published numerous technical papers and reports over the last thirty years; most of them are published in International journals and conferences. Some selected publications are listed below:

1. Participated, reviewed, and published more than 50 Technical Reports, Research Results Reports, and Technical Presentations – all published on the FRA e-library: https://railroads.dot.gov/elibrary-search#p1_z5_qD_kAcoustic
2. Hamed M., Ayyub B., Elsibaie M., and Omar T., “Connectedness Efficiency Analysis of Weighted U.S. Freight Railroad Networks,” *ASME Journal. Risk Uncertainty Part B*. Dec 2022, 8(4): 041202. Paper No: RISK-21-1072, Published online: April 28, 2022.
3. Mao, Y., Ayyub, B.M., Elsibaie, M., Saadat, Y., and Omar, T., 2021, “Optimizing Topology of Rail Networks: The Case of Reclassing, Acquisition and Repurposing of Tracks,” ASME Joint Rail Conference (JRC2021), April 20-21, 2021.
4. Cao, S. Ayyub, B.M., Saadat, Y., Elsibaie, M., and Omar, T., 2021, “Topological Analytics for Vulnerability and Recovery Enhancements After Disruption of Rail Networks,” ASME Joint Rail Conference (JRC2021), April 20-21, 2021.
5. Banerjee S., Hempel, M., Ghasemzadeh, P., Sharif H., and Omar T., “Wireless Communication for High-Speed Passenger Rail Service: Design and Evaluation of Unified Architecture,” *Proceedings of the 2020 Joint Rail Conference & JRC2020-8068*, St. Louis, MO, April 20-22, 2020.
6. Ghasemzadeh, P., Banerjee S., Sharif, H., and Omar T., “Evaluation of Machine Learning-Driven Automatic Modulation Classifiers Under Various Signal Models,” *Proceedings of the 2020 Joint Rail Conference & JRC2020-8091*, St. Louis, MO, April 20-22, 2020.

7. Ross J., Campbell, T., Parida, B., Arnoldy, M., and Omar T., "Development of Candidate New Emergency Warning Signals (EWS) to Improve Railroad Safety," *Proceedings of the 2017 Joint Rail Conference & [JRC2017-2281](#)*, Philadelphia, PA, April 4-7, 2017.
8. Sadaat, S., Omar T., Olson E., and Ranganathan, P., "The Federal Railroad Administration's Automated Grade Crossing Survey System," Presented at the AREMA 2015 Annual Conference, Minneapolis, MN, October 4-7, 2015.
9. Omar T., and Bedewi, N., "New Shallow Foundation Security Barriers for Urban Applications – FEA and Certified Actual Crash Test," *Proceedings of the ASME Winter Annual Meeting, Transportation Safety Session, [IMECE2009-12203](#)*, Orlando, FL, November 13-19, 2009.
10. Omar T., and Bedewi, N., and Hylton, T., "Cost-effective Structural Anti-Ram Barriers for Severe and Moderate Impacts - New Design, FEA, and Test Validation," *Proceedings of the ASME Winter Annual Meeting, [IMECE2007-41510](#)*, Seattle, WA, November 11-15, 2007.
11. Omar, T., and Bedewi, N., "Modeling of Automotive Fuel Tanks Using Smoothed Particle Hydrodynamics," *Proceedings of the Society of Automotive Engineering (SAE) World Congress*, Detroit, MI, April 16-19, 2007.
12. Omar, T., and Bedewi, N., "Advanced Benefit Analysis of the ITS-Airbag in Vehicles' Side Impacts – FE Simulation and Severity Analysis," *Proceedings of the 10th International Conference on Aerospace Sciences & Aviation Technology, ASAT-10*, Cairo, Egypt, May 13-15, 2003.
13. Omar, T., Bedewi, N., and Eskandarian, A., "Significant Severity Reduction of Side-Impact Injuries by Using ITS Airbags: FE Simulation and Severity Analysis," *Proc. ASME. [IMECE2002-39083](#)*, Transportation: Making Tracks for Tomorrow's Transportation, November 17–22, 2002.
14. Bedewi, N., and Omar, T., "Nonlinear FEA of Composite Materials for Crashworthiness Applications," 8th Annual International Conference on Composites Engineering, **ICCE/8**, Tenerife Island, Spain, August 5-11, 2001.
15. Omar, T., Eskandarian, A., and Bedewi, N., "Artificial Neural Networks for Modeling Dynamics of Impacting Bodies and Vehicles," *Journal of Multi-body Dynamics*, Vol. 214, Part K, pp. 133-142, 2000.
16. Omar, T., Bedewi, N., and Eskandarian, A., "Major Parameters Affecting Nonlinear Finite Element Simulations of Vehicle Crashes," *Proceedings of the ASME Winter Annual Meeting, Transportation Safety Session*, Nashville, TN, November 14-19, 1999.
17. Omar, T., Eskandarian, A., and Bedewi, N., "Vehicle Crash Modeling Using Recurrent Neural Networks," *Journal of Mathematical and Computer Modeling*, Vol. 28, No. 9, pp. 31-42, 1998.
18. Omar, T., Eskandarian, A., and Bedewi, N., "Crash Analysis of Two Vehicles in Frontal Impact Using Adaptive Artificial Neural Networks," *Proceedings of the ASME Winter Annual Meeting, Transportation Safety Session*, CA, November 15-20, 1998.
19. Omar T., Kan, C., and Bedewi, N., "Non-linear Finite Element Analysis of Box Beam Crush Buckling: Experimental Validation and Material Comparison," 29th International Symposium on Automotive Technology and Automation, Florence, Italy, June 1996.