

Jeffrey P. Chrstos, Ph.D.



PROPOSED ROLE: RESEARCH SCIENTIST

EDUCATION

PH.D. IN MECHANICAL ENGINEERING, THE OHIO STATE UNIVERSITY, COLUMBUS, OH, 2000

M.S. MECHANICAL ENGINEERING, THE OHIO STATE UNIVERSITY, COLUMBUS, OH, 1992

B.S. MECHANICAL ENGINEERING, DREXEL UNIVERSITY, PHILADELPHIA, PA, 1984

QUALIFICATIONS

Dr. Chrstos is a Research Scientist at The Ohio State Universities Center for Automotive Research, where he runs the Driving Dynamics Laboratory (DDL). The DDL does research on vehicle dynamics, and particularly on the interaction between drivers, vehicles, and their active safety systems. The DDL has a Driver-in-the-Loop simulator, which is being used in the study of the interaction between drivers and ADAS/AV systems.

Dr. Chrstos also is a consultant to Ford Motor Company in the area of vehicle dynamics. The last five years of this work have focused heavily on integrating a high end DiL into the development process of high-performance vehicles. In addition to the DiL work, Dr. Chrstos is responsible for tire testing and modeling for Ford's high-performance road vehicles.

KEY AREAS OF EXPERTISE

- Vehicle Dynamics and simulation
- Driver-in-the-Loop simulators
- Tire testing and modeling
- Active chassis safety systems

SELECTED RELEVANT EXPERIENCE

Ford Tire Modelling

PROJECT ROLE: PI and RESEARCH SCIENTIST

Ford has contracted OSU to evaluate commercial high frequency tire models to aid their CAE capability for vehicle ride dynamics. This project will integrate existing models into Ford's CAE tools and assess strengths and weaknesses based on Ford's data capabilities and workflow

needs. In addition, this project will assess current tire testing capabilities and recommend changes in testing procedures.

L3 AV Driver Hand-off

PROJECT ROLE: RESEARCH SCIENTIST

Funded through CAR's membership program, research on the DDL's DiL looking to create a virtual workbench for studying L3 AV control hand-on/hand-off. Representative lane assist and speed controllers have been developed using Model Predictive Control to allow L3 AV functionality in the DiL. This allows the driver to use the vehicle steering wheel controls to relinquish or re-take control of the vehicle during virtual driving.

PAST EXPERIENCE

1996 -	SELF EMPLOYED - JPC Engineering	COLUMBUS, OH.
Present	Vehicle Dynamics Consulting	

Specialize in road vehicle handling dynamics: simulation, data analysis, test program development, and parameter measurements. Experience with passenger car, heavy trucks, aircraft ground handling, and racing cars.

2016 to Present - primary customer: Ford Performance.

- Contracted to develop and transfer vehicle dynamics technology between racing and high-performance street car activities. Extensive use of driver-in-the-loop simulator for vehicle dynamics assessment

2014 to 2015 - primary customer: Honda Performance Development.

- Contracted to develop vehicle dynamics simulation technology to support HPD in the Indy Car series and other racing activities.

1998 to 2013 - primary customer: Ford Racing.

- Initially contracted to develop vehicle simulation for vertical dynamics for CART series. Led vehicle dynamics model development and programming in MATLAB/Simulink. Core requirement was extendable model that could support production and race vehicle analysis.
- 2000-2003 simulation extended to handle Ford Formula 1 and NASCAR projects.
- Involved in all model subsystem development, testing, and parameter determination.

- Led model extension to allow handling analysis.
- Simulation system has been the primary pre-race and race weekend tool used for 27+ NASCAR Sprint Cup wins and 30+ NASCAR Nationwide wins.
- Part time race engineer in Grand-AM Daytona Prototype series.

Feb 1999 - Systems Technology, Inc. HAWTHORNE, CA.
 2013 Principal Research Engineer

Vehicle simulation projects includes both real-time and analysis simulations running on PC hardware. Driver-in-the-loop simulator development project including vehicle dynamics simulation, driving scenario programming, network communication, steering force-feel system, and 3D graphics programming. Tire and driver modeling. Apply ground vehicle dynamics to aircraft ground handling.

Oct 1986 - TRANSPORTATION RESEARCH CENTER OF OHIO EAST LIBERTY, OH.
 Dec 1995 Contracted to: Vehicle Research and Test Center (US DOT / NHTSA)

Research Engineer - Primary area of research, vehicle directional stability and control. Develop test methods for measurement of suspension parameters and inertial values of production vehicles. Development of static rollover test devices. Develop/use vehicle dynamics simulations for use in automobile safety research. Develop/implement vehicle instrumentation packages and calibration procedures for full scale vehicle testing programs.

Conducted extensive vehicle dynamics simulation evaluation program for the NHTSA. Program responsibilities included; directing vehicle parameter measurements, executing full scale test program, and developing, with other engineers, the evaluation methodology.

Jun 1985- SELF EMPLOYED WILLOW GROVE, PA.
 Oct 1986 Engineering Software Development

Programmed microprocessors used to control aircraft instruments. Worked with Electrical Engineer on design of instrument computer circuits.

PARTICIPATION IN TECHNICAL ORGANIZATIONS:

Member: *Society of Automotive Engineers*

Co-Organizer **1990 - 2001 SAE International Congress and Exposition - Vehicle Dynamics and Simulation** Technical Sessions

Co-Organizer and Assistant Chairman **1991 SAE Passenger Car Meeting and Exposition - Vehicle Dynamics and Safety** Technical Session, Sept. 17, 1991

CONTINUING EDUCATION:

Mechanics of Heavy-Duty Trucks and Truck Combinations, Engineering Summer Conferences, The University of Michigan, July 11-15, 1988

Tire and Vehicle Dynamics, SAE Continuing Education, S. A. Lippmann, September 1990.

PUBLICATIONS:

Development of a Vehicle Model/Simulation Evaluation Tool, Howe, Chrstos, J. P., Romano, R., – SAE No. 2008-01-0778 SAE International Congress and Exposition, Detroit, April 2008.

Further Analysis of Potential Road/Terrain Characterization Rating Metrics J. G., Lee, C. C., Chrstos, J. P., Myers, T. T., Allen, R. W., Reid, A. A., and Gorsich, D. J., – SAE No. 2005-01-3562 SAE International Congress and Exposition, Detroit, April 2005.

Analysis of Potential Road/Terrain Characterization Rating Metrics, Howe, J. G., Lee, C. C., Chrstos, J. P., Myers, T. T., Allen, R. W., Reid, A. A., and Gorsich, D. J. – SAE No. 2004-01-2640, SAE Commercial Vehicle Engineering Congress & Exhibition, Rosemont, IL, October 2004.

Tire Modeling for Off-Road Vehicle Simulation, Liang, C. Y., Allen, R. W., Rosenthal, T. J., and Chrstos, J. P. – SAE No 204-01-2058, SAE 2004 Automotive Dynamics, Stability, and Controls Conference, Detroit, May 2004.

Quarter car model stress analysis for terrain/road profile ratings, Howe, J. G., Chrstos, J. P., Allen, R. W., Myers, T. T., Lee, D. C., Liang, C. Y., Gorsich, D. J., and Reid, A. A., International Journal of Vehicle Design, Vol. 36, Nos. 2/3, 2004.

Driver/Vehicle Modeling and Simulation, Allen, R. W., Aponso, B. L., Chrstos, J. P., and Lee, D. C., - SAE No 202-01-1568, SAE 2002 Automotive Dynamics and Stability Conference and Exposition, Detroit, MI, May 2002.

Validation of a non-linear vehicle dynamics simulation for limit handling, Allen, R. W., Chrstos, J. P., How J. G., Klyde, D. H., and Rosenthal, T. J., Proceedings of the Institution of Mechanical Engineers, Vol. 216 No D4, 2002.

Vehicle and Tire Modeling for Dynamic Analysis and Real-Time Simulation, Allen, R.W., Rosenthal, T. J., Klyde, D. H., and Chrstos, J. P. - SAE No. 2000-01-1620, SAE Automotive Dynamics and Stability Conference, Troy, May 2000.

A Low Cost PC Based Driving Simulator for Prototyping and Hardware-in-the-Loop Applications, Allen, R.W., Rosenthal, T. J., Aponso, B. L., Klyde, D. H., Anderson, F. G., Hogue, J. R., and Chrstos, J. P. - SAE No. 980222, SAE International Congress and Exposition, Detroit, February 1998.

Applying Vehicle Dynamics Analysis and Visualization to Roadway and Roadside Studies, Allen, R.W., Rosenthal, T. J., and Chrstos, J. P. – STI Report No. 1301-1, FHWA Contract No. DTFH61-93-C-00209, Draft Final Report, November 1997.

A Vehicle Dynamics Model for Low Cost, PC Based Driving Simulations, R. Wade Allen, Theodore J. Rosenthal, David H. Klyde, Jeffery R. Hogue and Jeffrey P. Chrstos, Proceedings of the Third Driving Simulation Congress, DSC97, Lyon, France, September 1997.

A Vehicle Dynamics Tire Model for Both Pavement and Off-Road Conditions, Allen, R.W., Rosenthal, T. J., and Chrstos, J. P. - SAE No. 970559, SAE International Congress and Exposition, Detroit, February 1997.

Methodology for Validation the National Advanced Driving Simulator's Vehicle Dynamics (NADSdyna), Garrott, W. R., Grygier, P. A., Chrstos, J. P., Heydinger, G. H., and Salaani, K. - SAE No. 970562, SAE International Congress and Exposition, Detroit, February 1997.

Experimental Testing of a 1994 Ford Taurus for NADSdyna Validation, Chrstos, J. P. and Grygier, P. A. - SAE No. 970563, SAE International Congress and Exposition, Detroit, February 1997.

Parameter Measurement and Development of a NADSdyna Validation Data Set for a 1994 Ford Taurus, Chrstos, J. P. and Salaani, K. - SAE No. 970564, SAE International Congress and Exposition, Detroit, February 1997.

Evaluation of VDANL and VDM RoAD for Predicting the Vehicle Dynamics of a 1994 Ford Taurus, Chrstos, J. P. and Heydinger, G. J. - SAE No. 970566, SAE International Congress and Exposition, Detroit, February 1997.

Land Vehicle Roll/Yaw Product of Inertia Measurement, Durisek, N. J., Heydinger, G. J., Chrstos, J. P., and Guenther, D. A., *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol. 119, Number 2, June 1997.

Instrumentation and Field Testing of 1994 Ford Taurus GL for NADSdyna Evaluation, Chrstos, J. P. and Grygier, P., NHTSA Final Report - Draft, 1996.

Parameter Measurement and Computation Procedures for 1994 Ford Taurus GL, Chrstos, J. P., NHTSA Final Report - Draft, 1996

Evaluation of the VDANL and VDM RoAD Vehicle Dynamics Simulations, Chrstos, J. P., NHTSA Final Report - Draft, 1996

Modeling of Dynamic Characteristics of Tire Output Responses to Concurrent Inputs, Lee, S., Heydinger, G. J., Chrstos, J. P., and Guenther, D. A., ASME, "Advanced Automotive Technologies - 1995" - DSC-Vol. 56, DE-Vol 86, pp. 91 - 98, 1995 ASME Winter Annual Meeting, November 1995.

Modeling of Dynamic Characteristics of Tire Lateral and Longitudinal Force Responses to Dynamic Inputs, Lee, S., Chrstos, J. P., and Guenther, D. A., SAE No. 950314, SAE International Congress and Exposition, Detroit, February 1995.

Non-Rigid Body Product of Inertia Measurement: Application to Land Vehicles, Durisek, N. J., Heydinger, G. J., Chrstos, J. P., and Guenther, D. A., ASME, "Transportation Systems - 1994 - DSC-Vol. 54, DE-Vol. 76", pp. 375 - 386, 1994 ASME International Mechanical Engineering Congress and Exposition, November 1994.

Simulation Evaluation Using the Side Pull Test, Chrstos, J. P., and Guenther, D. A., IMechE C466/029/93, International Conference on Vehicle Ride and Handling, Birmingham England, November 1993.

Simulation Evaluation Using the Side Pull Test, Chrstos, J. P., Master's Thesis, The Ohio State University Department of Mechanical Engineering, December 1992.

Error Analysis Techniques Applied to Vehicle Inertial Parameter Measurement, Chrstos, J. P., Heydinger, G. J., and Guenther, D. A., ASME, "Transportation Systems - 1992 - DSC-Vol. 44", pp. 97 - 112, 1992 ASME Winter Annual Meeting, November 1992.

Improving Vehicle Handling Simulation Via Sensitivity Analysis, Tandy, K., Heydinger, G. J., Chrstos, J. P., and Guenther, D. A., SAE No. 925042, IMechE No. C389/396, 24th FISITA Congress, London England, June 1992.

The Measurement of Static Rollover Metrics, Chrstos, J. P. and Guenther, D. A., SAE No. 920582, SAE International Congress and Exposition, Detroit, February 1992.

Evaluation of NHTSA Light Vehicle Handling Simulations, Chrstos, J. P. and Heydinger, G. J., NHTSA Final Report, August 1992.

The Inclusion of Steering System Freeplay in Open-Loop Vehicle Dynamic Simulations, Chrstos, J. P. and Heydinger, G. J., *Vehicle System Dynamics* Vol. 20, Pages 99-113, 12th IAVSD (International Association for Vehicle System Dynamics) Symposium, Lyon, France, August 1991.

An Evaluation of Static Rollover Propensity Measures, Chrstos, J. P., NHTSA Final Report No. DOT HS 807 747, May 1991.

The Importance of Tire Lag on Simulated Transient Vehicle Response, Heydinger, G. J., Garrott, W. R., and Chrstos, J. P., *SAE Transactions* No. 910235, SAE International Congress and Exposition, Detroit, February 1991.

A Simplified Method for the Measurement of Composite Suspension Parameters, Chrstos, J. P., *SAE Transactions*, Paper No. 910232, SAE International Congress and Exposition, Detroit, February 1991 (Reprinted in "Automotive Polymers and Design", Vol. 10, No. 5 and 6, June - August 1991).

Analysis of Rollover Characteristics of the Jeep CJ and Peer Vehicles, Kirkbride, R., Garrott, W. R., Heydinger, G. J., and Chrstos, J. P., NHTSA Report VRTC-70-0179, December 1990.

The Dynamic Effects of Tire Lag on Simulation Yaw Rate Predictions, Heydinger, G. J., Garrott, W. R., Chrstos, J. P., and Guenther, D. A., ASME, "Transportation Systems - 1990 - AMD-Vol. 108," pp. 77-86, November 1990. (also in ASME, "Journal of Dynamic Systems, Measurement and Control," June 1994)

A Methodology for Validating Vehicle Dynamics Simulations, Heydinger, G. J., Garrott, W. R., Chrstos, J. P., and Guenther, D. A., *SAE Transactions* No. 900128, SAE International Congress and Exposition, Detroit, February 1990.

Validation of Vehicle Stability and Control Simulations, Heydinger, G. J., Garrott, W. R., Chrstos, J. P., and Guenther, D. A., *Transportation Research Record*, TRB No. 1270, January 1990.

VEHICLE INERTIAL PARAMETERS - MEASURED VALUES AND APPROXIMATIONS, GARROTT, W. R., MONK, M. W., AND CHRSTOS, J. P., PAPER NO. 881767, SAE INTERNATIONAL CONGRESS AN