Stanford



J. Christian Gerdes

Professor of Mechanical Engineering, Emeritus

Bio

BIO

Chris Gerdes is a Professor Emeritus of Mechanical Engineering at Stanford University. His laboratory studies how cars move, how humans drive cars and how to design future cars that work cooperatively with the driver or drive themselves. Vehicles in the lab include X1, a student-built electric, steer-by-wire test vehicle; Takumi, a modified Toyota Supra capable of autonomous drifting in tandem with another car; and Marty, the electrified, automated, drifting DeLorean. Chris' interests in vehicle safety extend to ethics and government policy, having helped to develop the US Federal Automated Vehicle Policy while serving as the first Chief Innovation Officer of the US Department of Transportation.

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Mechanical Engineering

ADMINISTRATIVE APPOINTMENTS

- Chief Innovation Officer, United States Department of Transportation, (2016-2017)

HONORS AND AWARDS

- Best Paper Award, 12th International Symposium on Advanced Vehicle Control (2014)
- Rudolf Kalman Award, ASME Dynamic Systems and Control Division (2013)
- Villa Ladenburg Fellowship, Daimler and Benz Foundation (2012-2014)
- Arch T. Colwell Merit Award, SAE International (2006)
- Rudolf Kalman Award, ASME Dynamic Systems and Control Division (2006)
- Ralph R. Teetor Educational Award, SAE International (2005)
- Samuel M. Burka Award, Institute of Navigation (2004)
- Best Paper Award, 6th International Symposium on Advanced Vehicle Control (2002)
- CAREER Award, National Science Foundation (2002)
- Presidential Early Career Award for Scientists and Engineers, National Science Foundation (2002)
- Frederick Emmons Terman Fellowship, Stanford University (1998-2001)

PROGRAM AFFILIATIONS

- Center for Automotive Research at Stanford (CARS)

PROFESSIONAL EDUCATION

- BSE, University of Pennsylvania , Mechanical Engineering and Applied Mechanics (1990)

- BSEcon, University of Pennsylvania , Entrepreneurial Management (1990)
- MS, University of Pennsylvania , Mechanical Engineering and Applied Mechanics (1992)
- PhD, UC Berkeley , Mechanical Engineering (1996)

PATENTS

- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 11,614,752 Vehicle platooning systems and methods", Peloton Technology, Inc., Mar 28, 2023
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 11,474,538 Methods and systems for semi-autonomous vehicular convoys", Peloton Technology, Inc., Oct 18, 2022
- J Switkes, J Gerdes. "United States Patent 10,732,645 Methods and systems for semi-autonomous vehicular convoys", Peloton Technology, Inc., Aug 4, 2020
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 10,481,614 Vehicle platooning systems and methods", Peloton Technology, Inc., Nov 19, 2019
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 10,281,927 Systems and methods for semi-autonomous vehicular convoys", Peloton Technology, Inc., May 7, 2019
- J Switkes, J Gerdes. "United States Patent 10,162,366 Methods and systems for semi-autonomous vehicular convoys", Peloton Technology, Inc., Dec 25, 2018
- J Switkes, J Gerdes. "United States Patent 10,042,365 Methods and systems for semi-autonomous vehicular convoys", Peloton Technology, Inc., Aug 7, 2018
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 9,665,102 Systems and methods for semi-autonomous vehicular convoys", Peloton Technology, Inc., May 30, 2017
- J Switkes, J Gerdes, D Lyons, S Boyd, E Berdichevsky. "United States Patent 9,645,579 Vehicle platooning systems and methods", Peloton Technology, Inc., May 9, 2017
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 9,582,006 Systems and methods for semi-autonomous convoying of vehicles", Peloton Technology, Inc., Feb 28, 2017
- J Switkes, J Gerdes, E Berdichevsky. "United States Patent 8,744,666 Systems and methods for semi-autonomous vehicular convoys", Peloton Technology, Inc., Jun 3, 2014
- S Joe, Y Deguchi, Y-H Hsu, S Laws, J Gerdes. "United States Patent 7,845,218 Tire state estimator and tire state estimation method", Nissan Motor Co., Ltd., Leland Stanford Junior University, Dec 7, 2010
- D Bevly, J Gerdes. "United States Patent 6,681,180 Determination and control of vehicle sideslip using GPS", Leland Stanford Junior University, Jan 20, 2004

LINKS

- http://ddl.stanford.edu/: http://ddl.stanford.edu/

Publications

PUBLICATIONS

- **Modeling and Control for Dynamic Drifting Trajectories** *IEEE TRANSACTIONS ON INTELLIGENT VEHICLES*
  Weber, T. P., Gerdes, J.
  2024; 9 (2): 3731-3741
- **Shared Control Up to the Limits of Vehicle Handling** *IEEE TRANSACTIONS ON INTELLIGENT VEHICLES*
  Talbot, J., Brown, M., Gerdes, J.
  2024; 9 (1): 2977-2987
- **Computing the Lateral Compliance of the Racing Line Using Trajectory Optimization**
  Aggarwal, R. K., Gerdes, J. C.
  edited by Mastinu, G., Braghin, F., Cheli, F., Corno, M., Savaresi, S. M.
  SPRINGER INTERNATIONAL PUBLISHING AG.2024: 57-63
- **Neural Network Tire Force Modeling for Automated Drifting**
  Broadbent, N., Weber, T., Mori, D., Gerdes, J.
  edited by Mastinu, G., Braghin, F., Cheli, F., Corno, M., Savaresi, S. M.

SPRINGER INTERNATIONAL PUBLISHING AG.2024: 378-384

- **Modeling and Control for Dynamic Drifting Trajectories**
  Weber, T. P., Gerdes, J., IEEE
  IEEE.2024: 3151
- **Shared Control Up To The Limits of Vehicle Handling**
  Talbot, J., Gerdes, J., IEEE
  IEEE.2024: 3149
- **Trajectory Planning Using Tire Thermodynamics for Automated Drifting***
  Kobayashi, T., Weber, T. P., Gerdes, J., IEEE
  IEEE.2024: 2103-2109
- **High Speed Emulation in a Vehicle-in-the-Loop Driving Simulator**
  Weiss, E., Gerdes, J., IEEE
  IEEE.2024: 3153
- **Exploiting Linear Structure for Precision Control of Highly Nonlinear Vehicle Dynamics** *IEEE TRANSACTIONS ON INTELLIGENT VEHICLES*
  Peterson, M. T. T., Goel, T., Gerdes, J.
  2023; 8 (2): 1852-1862
- **High Speed Emulation in a Vehicle-in-the-Loop Driving Simulator** *IEEE TRANSACTIONS ON INTELLIGENT VEHICLES*
  Weiss, E., Gerdes, J.
  2023; 8 (2): 1826-1836
- **Learning Policies for Automated Racing Using Vehicle Model Gradients** *IEEE OPEN JOURNAL OF INTELLIGENT TRANSPORTATION SYSTEMS*
  Spielberg, N. A., Templer, M., Subosits, J., Gerdes, J.
  2023; 4: 130-142
- **Long-Horizon Vehicle Planning and Control Through Real-Time Iterations**
  Fors, V., Gerdes, J., IEEE
  IEEE.2023
- **Neural networks overtake humans in a racing game** *NATURE*
  Gerdes, J.
  2022; 602 (7896): 213-214
- **Long-Horizon Vehicle Motion Planning and Control Through Serially Cascaded Model Complexity** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
  Laurense, V. A., Gerdes, J.
  2022; 30 (1): 166-179
- **Combining Virtual Reality and Steer-by-Wire Systems to Validate Driver Assistance Concepts**
  Weiss, E., Talbot, J., Gerdes, J., IEEE
  IEEE.2022: 1709-1715
- **Neural Network Model Predictive Motion Control Applied to Automated Driving With Unknown Friction** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
  Spielberg, N. A., Brown, M., Gerdes, J.
  2021
- **Impacts of Model Fidelity on Trajectory Optimization for Autonomous Vehicles in Extreme Maneuvers** *IEEE TRANSACTIONS ON INTELLIGENT VEHICLES*
  Subosits, J. K., Gerdes, J.
  2021; 6 (3): 546-558
- **Game-Theoretic Planning for Self-Driving Cars in Multivehicle Competitive Scenarios** *IEEE TRANSACTIONS ON ROBOTICS*
  Wang, M., Wang, Z., Talbot, J., Gerdes, J., Schwager, M.
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- **Optimal Decision Making for Automated Vehicles Using Homotopy Generation and Nonlinear Model Predictive Control**
  Patterson, V. Z., Lewis, F. E., Gerdes, J., IEEE
  IEEE.2021: 1045-1050
- **On infusing reachability-based safety assurance within planning frameworks for human-robot vehicle interactions** *INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH*
  Leung, K., Schmerling, E., Zhang, M., Chen, M., Talbot, J., Gerdes, J., Pavone, M.
  2020
- **Learning at the Racetrack: Data-Driven Methods to Improve Racing Performance Over Multiple Laps** *IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY*
  Kapania, N. R., Gerdes, J.
  2020; 69 (8): 8232–42
- **Towards Automated Vehicle Control Beyond the Stability Limits: Drifting Along a General Path** *ASME Journal of Dynamic Systems, Measurement and Control*
  Goh, J. Y., Goel, T., Gerdes, J. C.
  2020; 142 (2)
- **Opening New Dimensions: Vehicle Motion Planning and Control using Brakes while Drifting**
  Goel, T., Goh, J. Y., Gerdes, J., IEEE
  IEEE.2020: 560-565
- **Robust Stabilization and Collision Avoidance through Minimizing Open-Loop Velocity Uncertainty**
  Brown, M., Gerdes, J., IEEE
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- **The Virtues of Automated Vehicle Safety - Mapping Vehicle Safety Approaches to Their Underlying Ethical Frameworks**
  Gerdes, J., IEEE
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- **On Infusing Reachability-Based Safety Assurance Within Probabilistic Planning Frameworks for Human-Robot Vehicle Interactions**
  Leung, K., Schmerling, E., Chen, M., Talbot, J., Gerdes, J., Pavone, M.
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  SPRINGER INTERNATIONAL PUBLISHING AG.2020: 561-574
- **Vehicle control synthesis using phase portraits of planar dynamics** *VEHICLE SYSTEM DYNAMICS*
  Bobier-Tiu, C. G., Beal, C. E., Kegelman, J. C., Hindiyeh, R. Y., Gerdes, J.
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- **Neural network vehicle models for high-performance automated driving** *SCIENCE ROBOTICS*
  Spielberg, N. A., Brown, M., Kapania, N. R., Kegelman, J. C., Gerdes, J.
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- **A Hybrid Control Design for Autonomous Vehicles at Uncontrolled Crosswalks**
  Kapania, N. R., Govindarajan, V., Borrelli, F., Gerdes, J., IEEE
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- **Game Theoretic Planning for Self-Driving Cars in Competitive Scenarios**
  Wang, M., Wang, Z., Talbot, J., Gerdes, J., Schwager, M.
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- **Contingency Model Predictive Control for Automated Vehicles** *American Control Conference*
  Alsterda, J. P., Brown, M., Gerdes, J. C.
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- **From the Racetrack to the Road: Real-Time Trajectory Replanning for Autonomous Driving** *IEEE Transactions on Intelligent Vehicles*
  Subosits, J. K., Gerdes, J. C.
  2019; 4 (2): 309-320
- **Toward Closing the Loop on Human Values** *IEEE Transactions on Intelligent Vehicles*
  Thornton, S. M., Limonchik, B., Lewis, F. E., Kochenderfer, M. J., Gerdes, J. C.
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- **Coordinating Tire Forces to Avoid Obstacles Using Nonlinear Model Predictive Control** *IEEE Transactions on Intelligent Vehicles*
  Brown, M., Gerdes, J. C.
  2019; 5 (1): 21-31
- **Designing Automated Vehicles Around Human Values.** *Road Vehicle Automation 6. AVS 2019.*
  Gerdes, J. C., Thornton, S. M., Millar, J.
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  Springer.2019
- **Mind over motor mapping: Driver response to changing vehicle dynamics** *HUMAN BRAIN MAPPING*
  Bruno, J. L., Baker, J. M., Gundran, A., Harbott, L. K., Stuart, Z., Piccirilli, A. M., Hosseini, S., Gerdes, J., Reiss, A. L.
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- **Mind over motor mapping: Driver response to changing vehicle dynamics.** *Human brain mapping*
  Bruno, J. L., Baker, J. M., Gundran, A. n., Harbott, L. K., Stuart, Z. n., Piccirilli, A. M., Hosseini, S. M., Gerdes, J. C., Reiss, A. L.
  2018
- **Value Sensitive Design for Autonomous Vehicle Motion Planning**
  Thornton, S. M., Lewis, F. E., Zhang, V., Kochenderfer, M. J., Gerdes, J., IEEE
  IEEE.2018: 1157-1162
- **Analysis of Feasible Tire Force Regions for Optimal Tire Force Allocation with Limited Actuation** *IEEE INTELLIGENT TRANSPORTATION SYSTEMS MAGAZINE*
  Park, H., Gerdes, J.
  2017; 9 (3): 75–87
- **Neural, physiological, and behavioral correlates of visuomotor cognitive load.** *Scientific reports*
  Hosseini, S. M., Bruno, J. L., Baker, J. M., Gundran, A., Harbott, L. K., Gerdes, J. C., Reiss, A. L.
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- **Collision Avoidance and Stabilization for Autonomous Vehicles in Emergency Scenarios** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
  Funke, J., Brown, M., Erlien, S. M., Gerdes, J.
  2017; 25 (4): 1204–16
- **Incorporating Ethical Considerations Into Automated Vehicle Control** *IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS*
  Thornton, S. M., Pan, S., Erlien, S. M., Gerdes, J.
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  Brown, M., Funke, J., Erlien, S., Gerdes, J. C.
  2017; 61: 307-316
- **Insights into vehicle trajectories at the handling limits: analysing open data from race car drivers** *VEHICLE SYSTEM DYNAMICS*
  Kegelman, J. C., Harbott, L. K., Gerdes, J. C.
  2017; 55 (2): 191-207

- **Path-Tracking for Autonomous Vehicles at the Limit of Friction**
  Laurense, V. A., Goh, J. Y., Gerdes, J., IEEE
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  Estrada, M. A., Kegelman, J. C., Gerdes, J., Cutkosky, M. R.
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- **A Synthetic Input Approach to Slip Angle Based Steering Control for Autonomous Vehicles**
  Subosits, J. K., Gerdes, J., IEEE
  IEEE.2017: 2297–2302
- **Design of Variable Vehicle Handling Characteristics Using Four-Wheel Steer-by-Wire** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
  Russell, H. E., Gerdes, J. C.
  2016; 24 (5): 1529-1540
- **A Sequential Two-Step Algorithm for Fast Generation of Vehicle Racing Trajectories** *JOURNAL OF DYNAMIC SYSTEMS MEASUREMENT AND CONTROL-TRANSACTIONS OF THE ASME*
  Kapania, N. R., Subosits, J., Gerdes, J. C.
  2016; 138 (9)
- **Shared Steering Control Using Safe Envelopes for Obstacle Avoidance and Vehicle Stability** *IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS*
  Erlien, S. M., Fujita, S., Gerdes, J. C.
  2016; 17 (2): 441-451
- **Simple Clothoid Lane Change Trajectories for Automated Vehicles Incorporating Friction Constraints** *JOURNAL OF DYNAMIC SYSTEMS MEASUREMENT AND CONTROL-TRANSACTIONS OF THE ASME*
  Funke, J., Gerdes, J. C.
  2016; 138 (2)
- **Predictive Haptic Feedback for Obstacle Avoidance Based on Model Predictive Control** *IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING*
  Balachandran, A., Brown, M., Erlien, S. M., Gerdes, J. C.
  2016; 13 (1): 26-31
- **Prescriptive and Proscriptive Moral Regulation for Autonomous Vehicles in Approach and Avoidance**
  Pan, S., Thornton, S. M., Gerdes, J., IEEE
  IEEE.2016
- **Motor learning affects car-to-driver handover in automated vehicles.** *Science robotics*
  Russell, H. E., Harbott, L. K., Nisky, I. n., Pan, S. n., Okamura, A. M., Gerdes, J. C.
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- **A SEQUENTIAL TWO-STEP ALGORITHM FOR FAST GENERATION OF VEHICLE RACING TRAJECTORIES**
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- **Autonomous Driving - Technical, Legal and Social Aspects**
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- **Simultaneous Stabilization and Tracking of Basic Automobile Drifting Trajectories**
  Goh, J. Y., Gerdes, J., IEEE
  IEEE.2016: 597–602
- **Design of a feedback-feedforward steering controller for accurate path tracking and stability at the limits of handling** *VEHICLE SYSTEM DYNAMICS*

Kapania, N. R., Gerdes, J. C.
2015; 53 (12): 1687-1704

- **An analytical method for reducing combustion instability in homogeneous charge compression ignition engines through cycle-to-cycle control** *INTERNATIONAL JOURNAL OF ENGINE RESEARCH*
  Jungkunz, A. F., Ravi, N., Liao, H., Erlien, S. M., Gerdes, J. C.
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- **Designing Steering Feel for Steer-by-Wire Vehicles Using Objective Measures** *IEEE-ASME TRANSACTIONS ON MECHATRONICS*
  Balachandran, A., Gerdes, J. C.
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- **Autonomes Fahren - Technische, rechtliche und gesellschaftliche Aspekte**
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- **Autonomous Vehicle Control for Emergency Maneuvers: The Effect of Topography**
  Subosits, J., Gerdes, J., IEEE
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- **Path Tracking of Highly Dynamic Autonomous Vehicle Trajectories via Iterative Learning Control**
  Kapania, N. R., Gerdes, J., IEEE
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- **Cooperative Collision Avoidance via Proximal Message Passing**
  Ong, H., Gerdes, J., IEEE
  IEEE.2015: 4124–30
- **Creating Predictive Haptic Feedback For Obstacle Avoidance Using a Model Predictive Control (MPC) Framework**
  Balachandran, A., Brown, M., Erlien, S. M., Gerdes, J., IEEE
  IEEE.2015: 31–36
- **Prioritizing Collision Avoidance and Vehicle Stabilization for Autonomous Vehicles**
  Funke, J., Brown, M., Erlien, S. M., Gerdes, J., IEEE
  IEEE.2015: 1134–39
- **Optimal tire force allocation for trajectory tracking with an over-actuated vehicle**
  Park, H., Gerdes, J., IEEE
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- **Implementable Ethics for Autonomous Vehicles** *Autonomes Fahren*
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- **A Controller Framework for Autonomous Drifting: Design, Stability, and Experimental Validation** *JOURNAL OF DYNAMIC SYSTEMS MEASUREMENT AND CONTROL-TRANSACTIONS OF THE ASME*
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  Widd, A., Liao, H., Gerdes, J. C., Tunestal, P., Johansson, R.
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- **Incorporating Non-Linear Tire Dynamics into a Convex Approach to Shared Steering Control** *American Control Conference*
  Erlien, S. M., Funke, J., Gerdes, J. C.
  IEEE.2014: 3468–3473
- **THE VIRTUAL WHEEL CONCEPT FOR SUPPORTIVE STEERING FEEDBACK DURING ACTIVE STEERING INTERVENTIONS**
  Balachandran, A., Erlien, S. M., Gerdes, J., ASME

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  Erlien, S. M., Jungkunz, A. F., Gerdes, J. C.
  2013; 135 (5)
- **Model Predictive Control for Vehicle Stabilization at the Limits of Handling** *IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY*
  Beal, C. E., Gerdes, J. C.
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- **Staying within the nullcline boundary for vehicle envelope control using a sliding surface** *VEHICLE SYSTEM DYNAMICS*
  Bobier, C. G., Gerdes, J. C.
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  Liao, H., Widd, A., Ravi, N., Jungkunz, A. F., Kang, J., Gerdes, J. C.
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  Mejia, J. P., Theodosis, P. A., Gerdes, J. C.
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- **NONLINEAR OPTIMIZATION OF A RACING LINE FOR AN AUTONOMOUS RACECAR USING PROFESSIONAL DRIVING TECHNIQUES** *5th Annual Dynamic Systems and Control Division Conference / 11th JSME Motion and Vibration Conference*
  Theodosis, P. A., Gerdes, J. C.
  AMER SOC MECHANICAL ENGINEERS.2013: 235–241
- **Modeling and Control of Exhaust Recompression HCCI SPLIT FUEL INJECTION FOR CYLINDER-INDIVIDUAL COMBUSTION CONTROL** *IEEE CONTROL SYSTEMS MAGAZINE*
  Ravi, N., Liao, H., Jungkunz, A. F., Song, H. H., Gerdes, J. C.
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  2012; 4 (32): 26-42
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  2012
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  Kritayakirana, K., Gerdes, J., Christian
  2012; 4 (10): 271-296
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- **Analysis of Measured Racing Lines: A Path Primitive Based Curve Fitting Approach**
  Koch, G., Kegelman, John, C., Gerdes, J., Christian
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- **Up to the Limits: Autonomous Audi TTS** *IEEE Intelligent Vehicles Symposium (IV)*
  Funke, J., Theodosis, P., Hindiyeh, R., Stanek, G., Kritatakirana, K., Gerdes, C., Langer, D., Hernandez, M., Mueller-Bessler, B., Huhnke, B.
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- **COMBUSTION PHASING VARIATION REDUCTION FOR LATE-PHASING HCCI THROUGH CYCLE-TO-CYCLE PILOT INJECTION TIMING CONTROL** *ASME Dynamic Systems and Control Conference / Bath/ASME Symposium on Fluid Power and Motion Control*
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- **A CONTROLLER FRAMEWORK FOR AUTONOMOUS DRIFTING: DESIGN, STABILITY, AND EXPERIMENTAL VALIDATION** *ASME Dynamic Systems and Control Conference / Bath/ASME Symposium on Fluid Power and Motion Control*
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- **GENERATING A RACING LINE FOR AN AUTONOMOUS RACECAR USING PROFESSIONAL DRIVING TECHNIQUES** *ASME Dynamic Systems and Control Conference / Bath/ASME Symposium on Fluid Power and Motion Control*
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  Kritayakirana, K., Gerdes, J. C.
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