24th October, 2013

Modeling for control – automotive emission control system case study

Mrdjan Jankovic

Senior Technical Leader
Ford Research & Advanced Engineering

Abstract: The low level of exhaust gas emissions from modern vehicles is a major achievement of automotive technology. Since the introduction of exhaust after-treatment catalysts, the emissions have been reduced by well over two orders of magnitude. Low emissions have to be maintained in the presence of hardware faults, degraded catalysts, and varying fuel composition such as ethanol content. Contributions to this achievement come from engine, chemical, and control engineering. The presentation will try to illuminate the role played by control and, in parallel, illustrate selection and application of models in control design. The models shown in this presentation range from very simple to very complex – from frequency domain to PDEs. Operation of the overall emission control system will be described and control design for several subsystems explained in some detail. The subsystems that are covered in the presentation are the "inner" fuel loop with the Smith Predictor, modeling for control of the "outer" catalyst loop, and adaptive ethanol detection in flex fuel vehicles. Experimental vehicle traces and emission test results will be used to illustrate benefits.

Biography: Mrdjan Jankovic received a bachelor degree from University of Belgrade, and master and doctoral degrees from Washington University, St. Louis. He held postdoctoral teaching and research positions with Washington University and UC Santa Barbara. He has joined Ford Research in 1995 where he is currently a Senior Technical Leader in the Powertrain Controls Department. Dr. Jankovic coauthored one book, three book chapters, more than 100 technical papers/ reports, and 50 US patents, 15 of which are implemented in Ford products worldwide. He received IEEE Control Systems Technology Award, two Ford Technical Achievement Awards, and three best paper awards from IEEE, SAE, and AVEC. Dr. Jankovic is a Fellow of the IEEE.