

Robust Control Design for Automotive Applications: A Variable Structure Control Approach

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1. Introduction

The steady rise in fuel prices and the increased awareness on climate issues led and still lead to considerable efforts in the development of automotive engines and drivetrains (Guzzella & Sciarretta (2005)). Thus, fuel savings and emission reduction are of general interest and obviously as important as improved riding comfort or driveability.

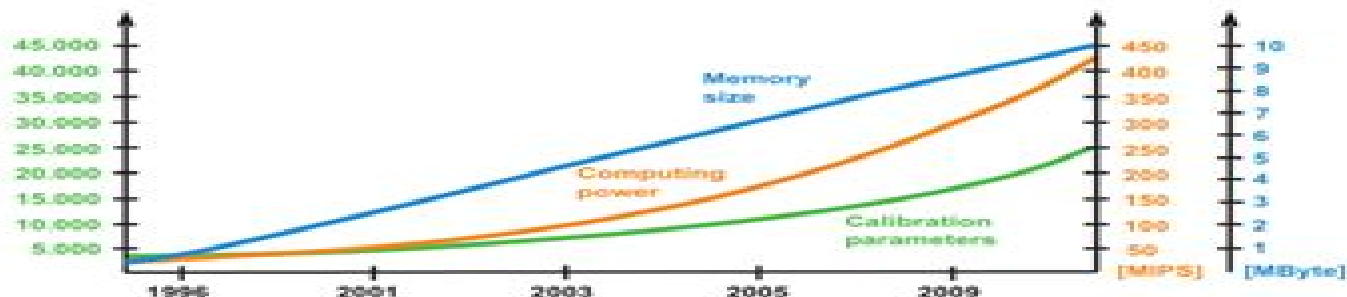


Fig. 1. Evolution of memory size, computing power and number of calibration parameters of an automotive engine control unit from 1996 to 2009 (ETAS GmbH (2010))

However, it is hard to find a suitable trade-off between all of these requirements and many resulting solutions lead to increased complexity of the vehicle systems. This is in particular true for common automotive combustion engines where the number of free calibration parameters of the corresponding electronic control unit (ECU) software has been increased up to five times during the last fifteen years (see Figure 1). From today's state of the art it takes up to five calibration engineers one whole year to finish all the calibration work on a series-production engine (Reif (2007)). Consequently, this time consuming calibration results in considerable development cost. Since the complexity of future drivetrains (e.g. battery electric vehicles or hybrid electric vehicles) will be drastically increased (Ehsani et al. (2010)) an ongoing rise on development cost is inevitable. However, with this effect cars may become

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