OPTIMIZATION OF IC ENGINE DESIGN FOR REDUCED EMISSIONS USING AUTOMATED ENGINE EXPERIMENTS AND CFD MODELING

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A fully-instrumented Caterpillar SCOTE 3401 heavy-duty engine has been configured for conducting automated optimization experiments using Genetic Algorithms (GA) and Response Surface Method (RSM) search techniques. Optimization studies have been conducted over five steady-state operating points of the FTP procedure, and significant improvements have been demonstrated in engine-out soot and NO_x and BSFC under some conditions. Additional optimization results have been obtained using multidimensional CFD modeling in conjunction with the GA methodology. Factors including injection timing, injection pressure, injection rate-shape, combustion chamber piston bowl geometry, turbo-charger boost pressure, and EGR have been explored. The methods have also been used to optimize the geometry of large- and small-bore diesel engines and to specify optimum injection rate-shape profiles for multiple injections in the Caterpillar engine.