System for Online Internal Combustion Engines Optimization

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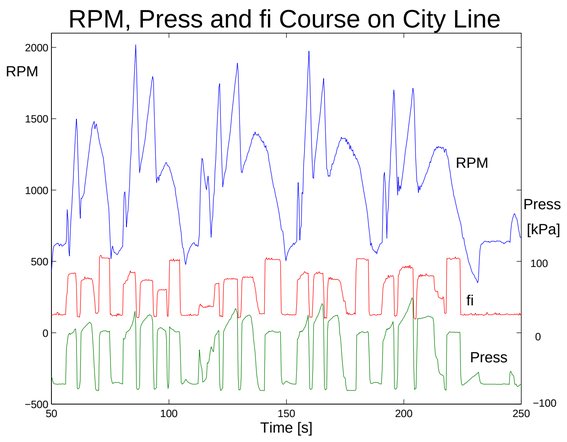
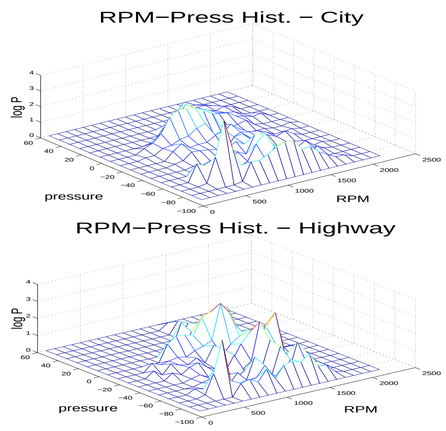
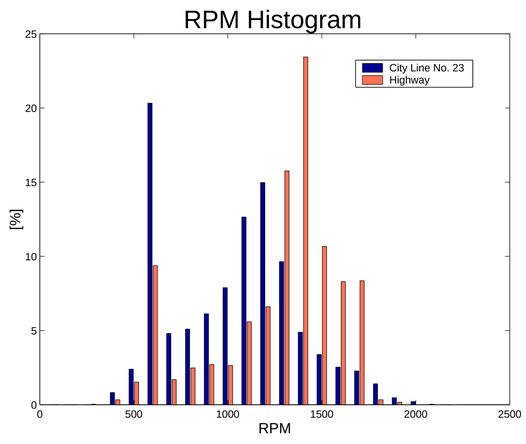
Statistics of Engine States

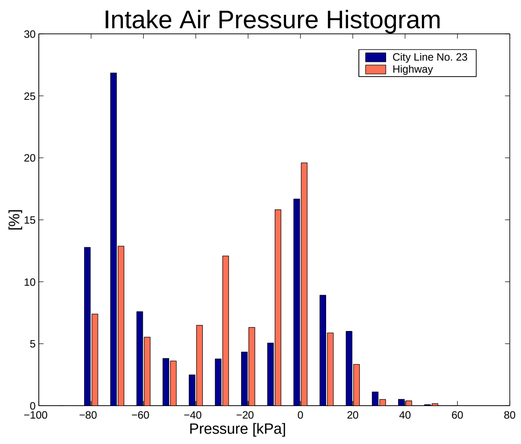
The statistics of engine working states can help to focus on areas of engine state space, which contributes most to overall efficiency and other economical, dynamic and ecological aspects of engine operation.

We have equipped an ignition control unit with the possibilities to acquire on-line data. The units are used for ignition and gas management control in natural gas powered city buses. Measured courses and statistical results for bus traffic in city and on highway are shown in next figures.









Measured data show the difference between a typical city traffic (acceleration and breaks from one bus stop to other one) and more smooth traffic on an inter-city line on highway. Data measured on Bratislava bus line No. 23 were taken as an example of city traffic.

An experimental city-bus and test equipment at workshop are in the next pictures.

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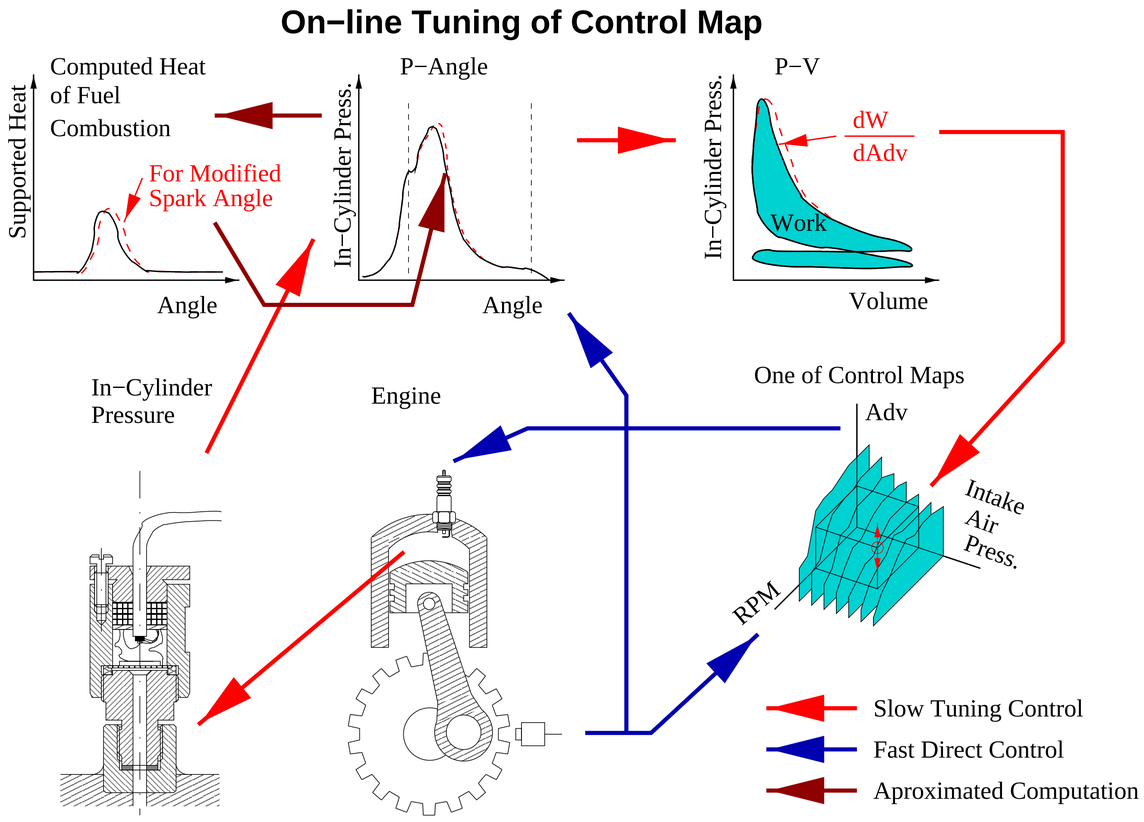
On-line Tuning of Control Maps

Because of need of fast response to state changes, a fast control of engine inputs parameters (ignition timing, fuel/air ratio etc.) is realized by control maps stored in memory of an engine control unit. But after fast response to state change more sophisticated algorithms are used to achieve better combustion efficiency. These slower loops include λ-gauge controlled fuel/air ratio and another indirect measurements of combustion efficiency.

Our method enables to optimize engine control for the highest amount of gained energy for actual engine state. It can be achieved by approximate computation of supported heat course, which can be used for computation of gained energy from modified cycle. If we are able to estimate gained energy of the cycle with slightly modified ignition timing, we can decide, which direction of ignition timing modification can increase energy income.

For most controllers, ignition timing dependence on the engine state (intake pressure, speed-RPM) is stored in the form of multidimensional table (map). Cell representing timing for engine state at the moment of pressure course measurement can be modified according to the previous computation.



Above described method for optimization of ignition timing for each working state is in preparation for experiments. We have developed additional software for our ECU and designed and produced low cost pressure gauge for experiments.