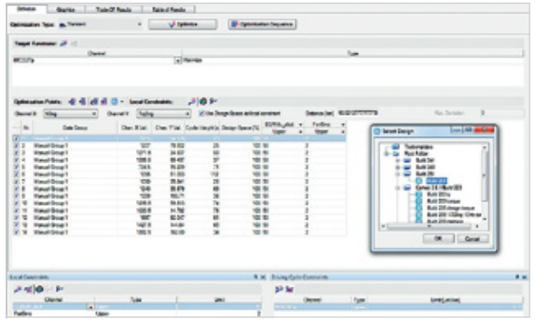
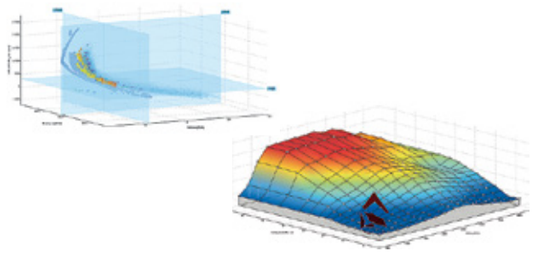
Top: Imported Cycle Points from CAMEO Design
Bottom left: CAMEO TradeOff Graphic for Evaluation of the Optima
Bottom right: Optimzed Map





Step 5. Optimization with cluster points

The design can then be imported into the CAMEO optimization task. All clustered speed/load points and all parameterized maps are used in the optimization task.

A new drive cycle calculation ensures that the result in CAMEO is calculated in relevant, physical units [g/km].

During the calculation the optimization results are displayed in the maps and can be merged and stored afterwards.

With these optimized maps downloaded to the controller, a verification test can be completed on the chassis dynamometer.

THE KEY BENEFITS OF AVL CAMEO EMISSION CALIBRATION

Reduced Time for Emission Calibration: Variant Calibration

A significant reduction in time for the whole emission calibration is the real result from having global CAMEO models that can be reused for every vehicle variant.

Saving Time by Having Good Optimization Results

Legislation tests on the chassis dynamometer can be done earlier and less iterations are needed to fulfill the targets.

Less Number of Expeditions Needed

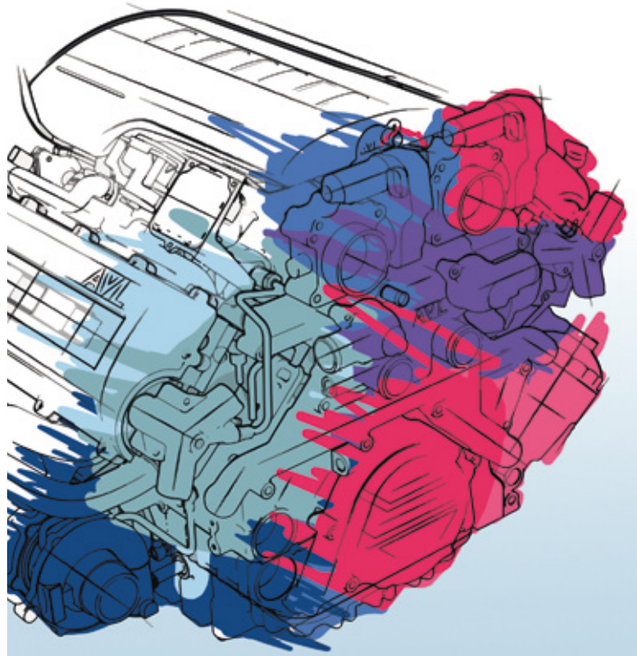
A good optimization result helps to find the best calibration with a lower number of expeditions.

One Tool

The integration of the complete calibration workflow into one tool improves the efficiency and the consistency of the calibration process.

Integration with V-Development Process

Cameo is integrated into processes at many positions of a typical V-Development cycle. It can be used to accelerate many procedures, using advanced design and modeling approaches.



AVL CAMEO All-In-One Powertrain Calibration

Emission Calibration

FOR FURTHER INFORMATION PLEASE CONTACT:

AVL List GmbH, Hans-List-Platz 1, A-8020 Graz, Austria
Phone: +43 316 787-0, Fax: +43 316 787-400
Email: info@avl.com, www.avl.com

PA3025E, Classification Public

Chassis Dyno Test Bed

FASTER EMISSION CALIBRATION WITH CAMEO MODEL BASED APPROACH

Emission calibration is a challenging task in the calibration process. Legislation has demanded a decrease in the limits for emissions several times over the last decade (e.g.: Euro3, Euro4, Euro5,..).

The target is to optimize a new vehicle variant for lowest fuel consumption, while fulfilling emission legislation and having good attributes - low noise, dynamic response and good driveability.

The legislation tests for a driving cycle are implemented on a chassis dynamometer. A driving cycle recorder file is used as input for a CAMEO design. From this design, measurement data from the engine form the base of a global engine model. This is used to find the optimal criteria for the engine controller calibration maps.

A STEP-BY-STEP GUIDE

Step 1. From drive cycle files to the area of design

Several vehicle recorder data files from a chassis dynamometer vehicle test can be imported into this CAMEO design. For each vehicle a different drive trace exists and is utilized in the design.

The engine has to fulfill the full operating envelope of speed and load for all different vehicle variants. This area can be displayed and extended in the CAMEO design, if necessary. Via constraints in CAMEO the area can be limited if required. For example we could reject all the points of speed lower than 650rpm. This would ensure that the only points in the design are those which have an influence on the emission and those which can be executed on the engine test bed. The drive traces can be identified by different colors, and viewed over time.

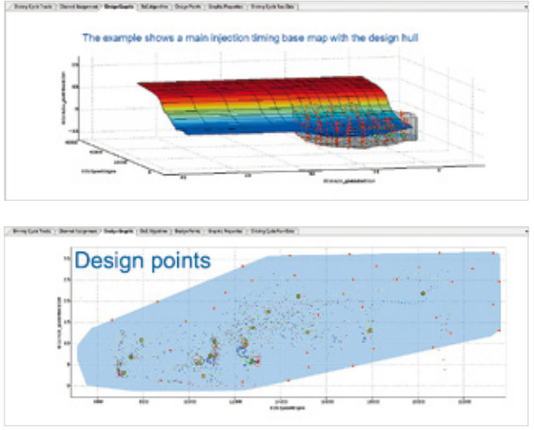
Drive Traces in CAMEO; over Time and over Speed/Load

Step 2. Creating cluster points and DoE Design

From the imported drive trace data CAMEO locates the speed/load points, which have the most influence on the emissions of the engine via a clustering algorithm. The user can define how many clustered points should be used for the calibration according to their needs.

Input parameters which can be varied on the engine test bed can be defined via calibration maps which are easily imported. Then, a „from-to" range defines the design hull.

From this information, an S-optimal DoE design is calculated. In addition to the clustered speed/load points the total area of interest is filled up with design points.



Top: Design Hull over Map
Bottom: Design Points and Cluster Points within the Hull

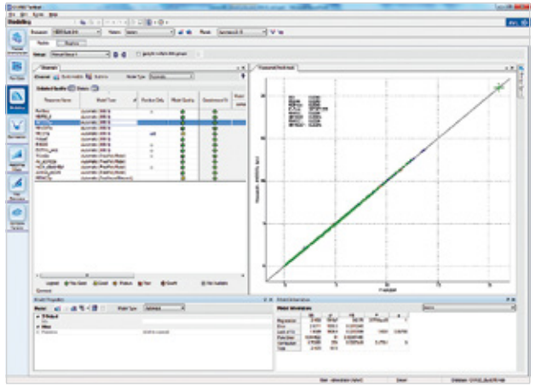
Step 3. Run Test on Engine Test Bed

The created design is imported to a CAMEO DoE test run and executed on the engine test bed. All relevant parameters are measured and stored in the CAMEO database.

Step 4. Creating global models

With the measurement data from the engine test bed, a global model is built. The ‚Automatic' modeling mode helps the user to find a high quality model in one click. A graphic and the overall model criterion gives feedback to the overall model quality.

The new iNN2 modeling algorithm ensures an excellent model, even for very complex response surfaces.



Automatic Building of good Global Models with Visualization