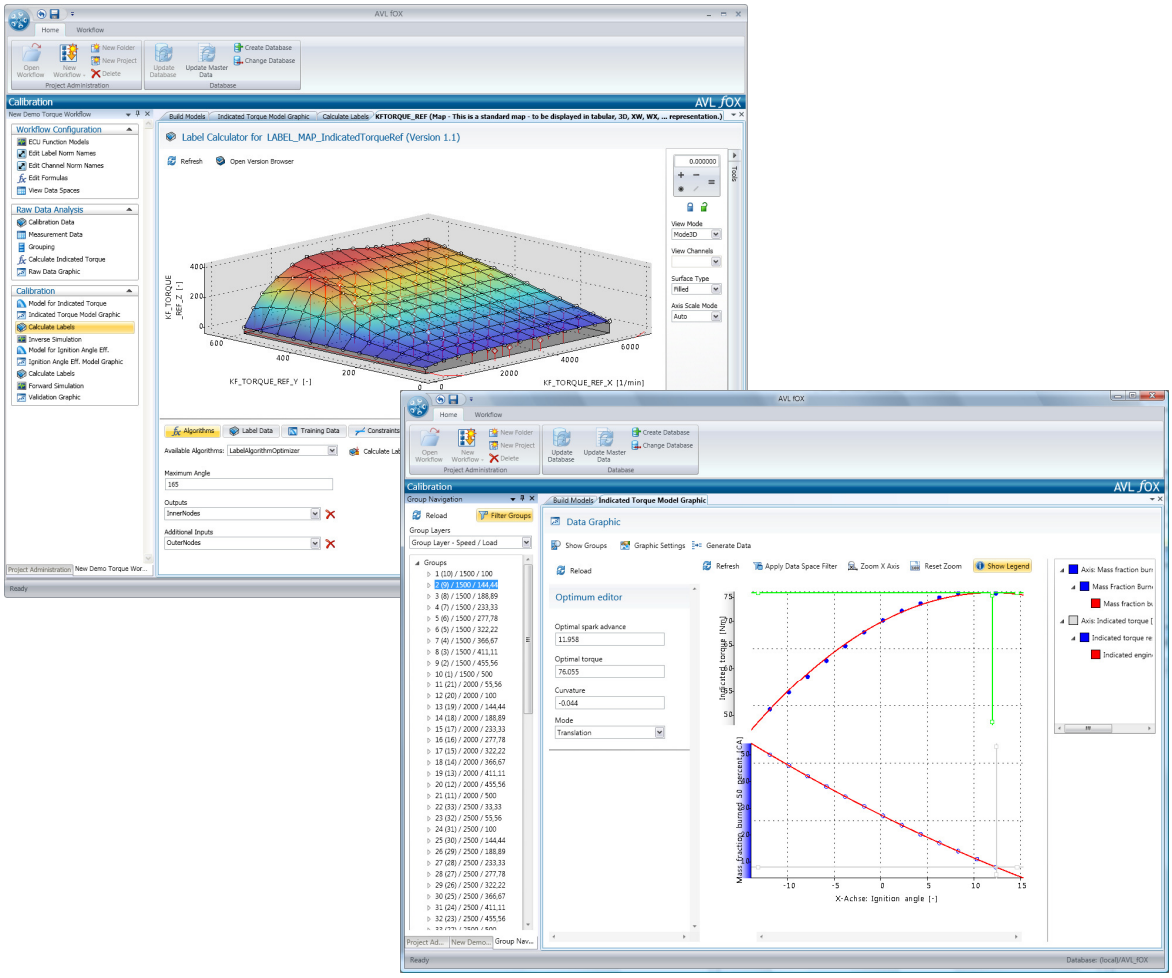
SMART CALIBRATION

AVL *f*OX – TORQUE MAPPING

AN AVL *f*OX WORKFLOW

Definition of Torque Mapping

Torque mapping is a methodology to calibrate an ECU function for gasoline engines, which determines the engine torque for different driving conditions in the vehicle. AVL fOX Torque Mapping workflow represents an ECU specific methodology that supports calibration engineers in the post-processing phase (conversion of the testbed data, which are for example collected with CAMEO iProcedures, to ECU parameters), using embedded technologies that allow easy data plausibility checks, integrated ECU function simulation, automated script execution, and powerful map interpolation.



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How it is implemented in fOX

Workflow Configuration

In this workflow task the main settings for the whole workflow can be reviewed and modified. Here you have to define the ECU functions you want to simulate (compiled Simulink files), the formulas you need (e.g. indicated torque calculation), the measurement data file, the name of channels and ECU labels. Generally, this workflow task needs to be considered only the first time.

Measurement Data Import

In this workflow step measurement data can be imported guided by a wizard. Different file formats and data settings are supported (TXT, CSV, MDF, etc.) and various pre-defined CSV settings (e.g. CAMEO V3.3 export format) are available. AVL fOX also provides different methods to select the channels that shall be imported. A powerful Aliasing system allows a flexible assignment of variable channel names used on the testbed to unique Alias names used in the workflow.

Calibration Data Import

Here the calibration labels are imported guided by a wizard (as DCM file format). AVL fOX also provides different methods to select the labels that shall be imported. The Aliasing system allows a flexible assignment of variable and complex label names from the ECU to expressive Alias names used in the workflow.

Raw Data Plausibility

In this workflow step the calibration engineer is able to find and take out bad measurement values or mark data that shall not be considered for the following calibration steps.

Modeling

For every operating point the torque depends on the spark advance, for example through a 2nd order function. In this workflow step the 2nd order regression model is built to calculate the engine torque. Using this model different values like maximum torque or optimum spark advance are calculated. Those are further used for several label calculations.

Label Calculation

The values extrapolated from the 2nd order model have to be converted into the labels of the ECU function. A bilinear interpolation algorithm is available as well as smoothing features, constraint settings, boundary settings and visualization features.

Simulation

Once labels are calibrated, it's time to simulate the torque prediction function in order to compare the measured vs. the simulated values. The used formats are Simulink models that are compiled using the Real-Time Workshop or formulas, which substitute graphical Simulink models with a line of text.

Validation

Here the measured vs. simulated torque is visualized. This offline validation is done before going back to the testbed and flash the ECU with new data.

Verification

In this workflow step the calibration results can be checked by using verification data from the testbed or the vehicle compared to simulated data. Different plots are available to show differences and remaining residuals.