**SIMULATED PASS-BY IN THE TIME DOMAIN**

Time Interpolated Passby Simulation (TIPS) is a function integrated into the pass-by application that determines a new time signal by overlaying the individual microphone time signals by using position and speed information. In the simulated pass-by, the time signal is used to evaluate the run. This is carried out for the left and the right side.

The run-times are automatically calculated from the geometry and sound speed and, subsequently, the signals for compensating the different time delays between the vehicle’s reference point and the pass-by microphones are synchronized. In order to achieve realistic aural perceptions, particularly for constant runs, the pass-by measurements are automatically recorded with and without the Doppler effect that is derived from the distance and speed information.

**PAK CONTRIBUTION ANALYSIS**

The PAK contribution analysis in the PAK 5.x NVH software allows individual contributions of the exterior noise to be extremely quickly separated by Transfer Path Analysis (TPA) methods. Main sources are recorded by local sensors (microphones) during a simulated pass-by measurement. Subsequently, the contribution of each source is determined on each of the [remotely positioned] pass-by microphones, by means of an Operational TPA. This results in several (simulated) pass-by measurements where each represents the contribution of a source. Thus, vehicle developers can quickly run individual sources through (e.g. an exhaust system) and then draw conclusions for engineering and an optimal vehicle tuning.

Effective recording of noise-related data enables a cause-related representation of the interrelationship between source and respective contribution. Characteristic sounds of individual components are taken into account in the process chain.

**CORRECTION OF TIRE ROLL NOISE**

Tire roll and track noise are crucial to engineers when it comes to indoor homologation, as these, along with drivetrain noise, are a major source of a vehicle’s pass-by noise. The increased alignment of homologation criteria towards urban driving demand more emphasis upon tire/track noise optimization.

Alongside the tire’s signature on the roll, the tire’s signature on an actual track is recorded and included in the simulation so that the roll contribution can then be used. The entire vehicle-tire-roll noise can be separated into a roll- and load-noise in order to enable a quick “virtual” tire-change on the test bench for the simulated pass-by. This is followed by:

- The analysis and simulation of the roll contribution (torque-free rolling tire);
- The analysis and simulation of the load contribution (transfer of drive torque to the tires);
- Finally, the synthesis to predict the tire/track noise across vehicle dynamics profiles. The tire/track noises synthesize to a given driving profile of roll and load contribution on the measurement track.

Corrections to tire-roll noise can be made using PAK pass-by 1.10 and PAK 5.x.

**PAK PASS-BY 2.0. SIMULATED PASS-BY.**

In vehicle development, determination of the entire exterior noise is, besides real pass-by measurements, increasingly being done on the basis of simulated pass-by measurements and tire roll noise simulation. The reasons for this include the all-season availability of test benches and the precise reproducibility of measurements thanks to constant conditions (temperature, wind or background noise), which allow for fast comparative testing and, therefore, better comparability of modifications to vehicles.

Simulated pass-by is a measurement method that enables type testing of vehicles according to UN ECE 51.03 Rev. 3 Supplement 4. This standard is currently in process.
Order-based working guarantees fast test cycles, high user-comfort and a high degree of division of labor. Series responsible or acousticians can order measurement sessions or test scenarios. The corresponding measurement responsible takes on the order, adds further data, if necessary, for standard compliance and to describe the vehicle, before executing the measurements systematically and efficiently. The measurement track and test bench are only required for the actual measurements. Preparation and vehicle configuration can be done outside of the test bench.

The PAK pass-by application guides the user, target-oriented through the measurement task. The tester receives the results immediately. Measurement data from partial orders that belong to one task are automatically exchanged.

An order always reflects the current state at any time, and contains the descriptive data and the standard-specific or vehicle-specific measurement tasks which are consolidated in measurement sessions. This allows, for example, the validation of a vehicle according to various standards, or the validation of vehicle types with different components.

Orders can be expanded or modified during processing, and measurement results can be added continuously. All information is consolidated in one place. Data is stored in ASAM ODS ATF/X format, and can therefore easily be processed further.

An order can be created in the PAK pass-by application using the PAK ODS order editor, and/or through external systems, such as openMDM™ tools.

PAK pass-by combines several components of the PAK family that optimally support clients, measurement technicians and testers in their individual tasks.

The PAK ODS order editor enables the creation and editing of ATF/X order files. PAK live software, with its PAK cloud IO service and PAK live connect, manages the connection of all PAK MKII frontends and enables data streaming. The PAK weather server provides data, such as air temperature, air pressure, humidity, wind speed, wind direction, and road surface temperature. PAK scope provides users with a quick overview of time blocks or Auto Power Spectra (APS) in real-time, and supports the channel configuration. The PAK device configuration manages the settings of all measurement devices on one test bench. PAK live SyncLink synchronizes all PAK MKII Frontends phase-synchronously.

With the PAK pass-by application, both real and simulated pass-by measurements can be executed. PAK cloud manages measurement data through its depot service.

Each component is extremely powerful. All measurement data is consolidated in one place. Users have everything present at all times, can intervene if necessary and benefit from being clearly guided through the measurement procedure. In addition, users can quickly and effectively measure a variety of global standards.

**SUPPORTED STANDARDS**

- UN-ECE R51.03
- UN-ECE R51.03 R2
- UN-ECE R51.03 Truck
- UN-ECE R51.03 Truck R2
- UN-ECE R51.03 ASEP
- UN-ECE R51.03 ASEP R2
- UN-ECE R51.02
- UN-ECE R41.03
- UN-ECE R41.04
- UN-ECE R41.04 ASEP
- US CFR49 Part 571.141
- US CFR40 Part 205D, F76a
- TRIAS_30_J09040_01
- GB_1495, 2002
- Open Pass-by
- MON_RPT_2010_00466, Braking
- UN-ECE R117
- Idle Noise Measurements acc. to UN-ECE R117
- UN-ECE R138
- UN-ECE R138 test bench and simulation
- US CFR49 Part 571.141