

**H3S (Code 7007)**

**HEAD 3D Sound Simulation System**

Software for the authentic simulation of airborne sound and vibrations



**Features**

- Software for authentic acoustic and tactile simulation of driving situations
- Interactive control of vehicle sound (e.g. via accelerator pedal, brakes, gear / automatic transmission)
- Separate playback (synthesis) of engine, tire, wind, background and other sounds
- Switching between different engines possible during the simulation
- Replacement of soundscapes, vehicle types, engines etc. at the click of a button
- Up to 100 individually configurable scenarios can be stored
- Optimization of sound components and vibrations during the simulation
- Channel-selective real-time filtering (e.g. engine, tire and wind sounds as well as vibrations)
- Integration of a visual driving simulation (driving straightforward) in the stationary mode
- Authentic order synthesis with accurate signal levels
- Control of filters and order generators depending on load and speed/RPM
- Customizable user interface (H3S control module)
- Socket control for seamless integration of H3S into existing simulators
- Network-compatible
- Direct interface to the PROGNO[ISE] software: specific examination of individual noise phenomena (up to 10 critical paths) via binaural transfer path synthesis
- Versatile:
  - in stationary driving simulators
  - in the SoundCar from HEAD acoustics
  - in listening studios (without structure-borne noise)
  - at desktop workplaces (without structure-borne noise)
  - in stock vehicles during real drives (mobile version)

**Overview**

The HEAD 3D Sound Simulation System H3S is a software for the interactive playback and simulation (airborne sound and vibrations) of vehicle interior noise.

H3S adapts sounds and vibrations to the individual "driving situation" and reacts in real-time to changes in speed, RPM, throttle position, etc. During the simulation, H3S allows the interactive replacement of engines, other components and much more. Modifications are working immediately and allow a realistic prediction of the effects.

In driving simulators, in the SoundCar from HEAD acoustics (an actual car without engine, turned into a simulator), in listening studios, at a desktop workplace, but also in any stock car during real drives, H3S puts noise judgement on a solid basis, since it fulfills the most important requirements for subjects to experience a lifelike driving situation ("immersion").

The multidimensional experience (hearing, feeling, seeing), the interactive operation, and the playback environment allow the proband to receive a realistic impression.

Due to the high correlation of the judgement results with the original impression, H3S is excellently suited for the virtual engineering, for the definition of target sounds, for A/B comparisons of different vehicle types (engines etc.), for the judgement of operating control sounds and many other purposes.

## Simulation

A soundscape created by H3S consists, for example, of the following individual sound components: engine with gear-box, tires and brakes, wind and background noise as well as operating control elements and indicators.

The sounds of oncoming and overtaking vehicles are created via binaural synthesis. For quickly “moving” sounds, the Doppler effect is simulated, too.

The driving dynamics model in the H3S Control module polls the operating controls of the vehicle and controls the actual H3S sound system. The “user interface” consists of ignition switch, accelerator pedal, brake pedal and gearshift lever as well as the dashboard instruments of the vehicle. The user can choose between conventional and automatic transmission.

Via the H3S Control module, it is also possible to control customer-specific extensions, for example the simulation and virtual replacement of turn signal units or windscreen wiper models.

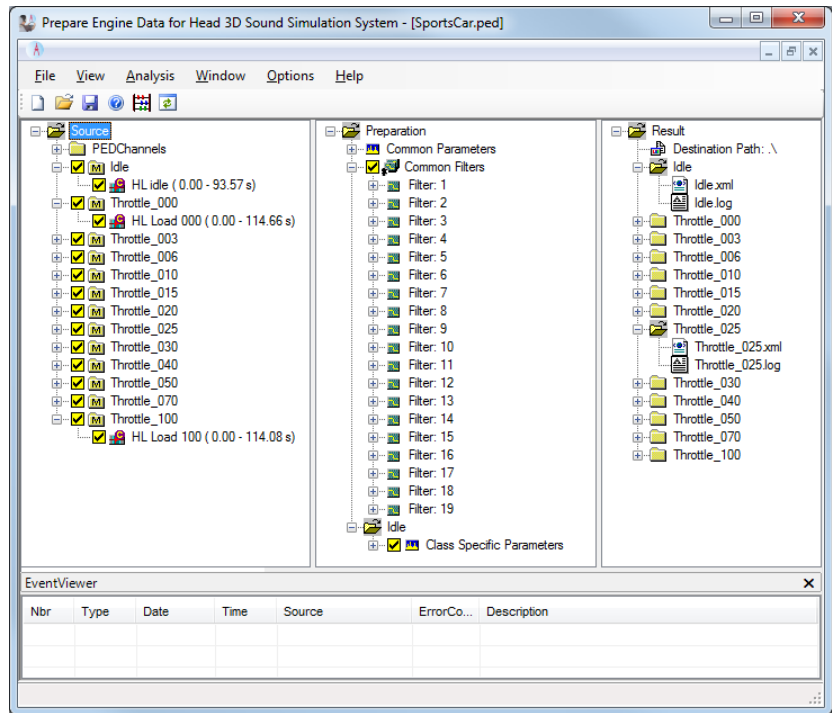
During the simulation, H3S plays the pre-recorded sound segments depending on the vehicle state. An innovative synthesis algorithm allows H3S to react to changes of the driving situation in real time. Furthermore periodically repeating sound patterns during constant driving situations are avoided.

## Sound Design

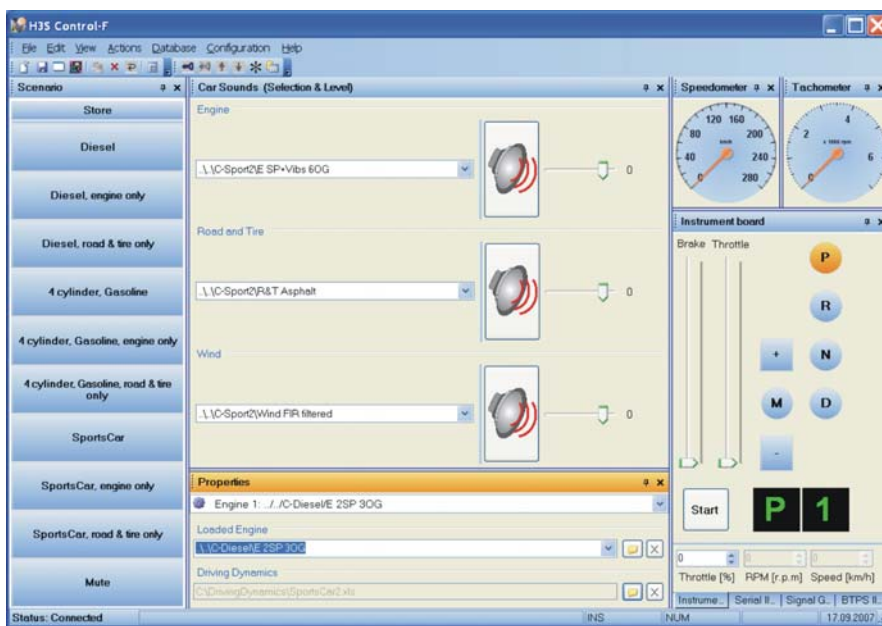
H3S offers the possibility to switch individual or several sound components (e.g. engine, tires, wind) or vibration channels off or on before or during the simulation. All sound components as well as the low-frequency vibration components can be modified by filtering and order synthesis, allowing for a selective intervention or modification during the simulation in a stationary or

mobile driving simulator. The various filters and order synthesis algorithms have an immediate effect depending on the driving situation.

The order generators of H3S can also be used to generate new orders. Engine noise can be generated from orders as needed.



The H3S Prepare Engine Data allows an individual configuration of run-ups with different engine loads. Then it allows to calculate them automatically.



The user specific and customizable H3S control module is used to control the simulation.

## Requirements

The binaural signals required for the simulation can be obtained, for example, from customer-specific engine simulation tools or recordings made on a chassis dynamometer (run-ups at different engine loads). A tool for the easy preprocessing of the recording is included. Road recordings made with the engine turned off provide the wind and tire sounds, pass-by measurements at different speeds are used for the sounds of other vehicles.

## Playback Environments

In stationary simulators, such as the SoundCar, headphones or an equalized four speaker system can be used for the playback of the sounds. The vibrations, for example of the steering wheel or the seat, are controlled by H3S via shakers depending on the driving situation chosen by the driver.



H3S in the SoundCar from HEAD acoustics



H3S with the NVH desktop simulator

Furthermore, H3S allows an interactive acoustic and visual simulation with the desktop NVH simulator too.

In mobile use, i.e. in an actually moving vehicle, the test driver enters a real driving situation. The acoustic playback takes place via a headphone and a subwoofer. Via optical sensors or via the CAN bus, H3S is permanently provided with all required information about the vehicle state and immediately reacts to changes during the drive. The easy and convenient operation via the H3S Control module (included with the base version) is especially advantageous in a mobile driving simulator.



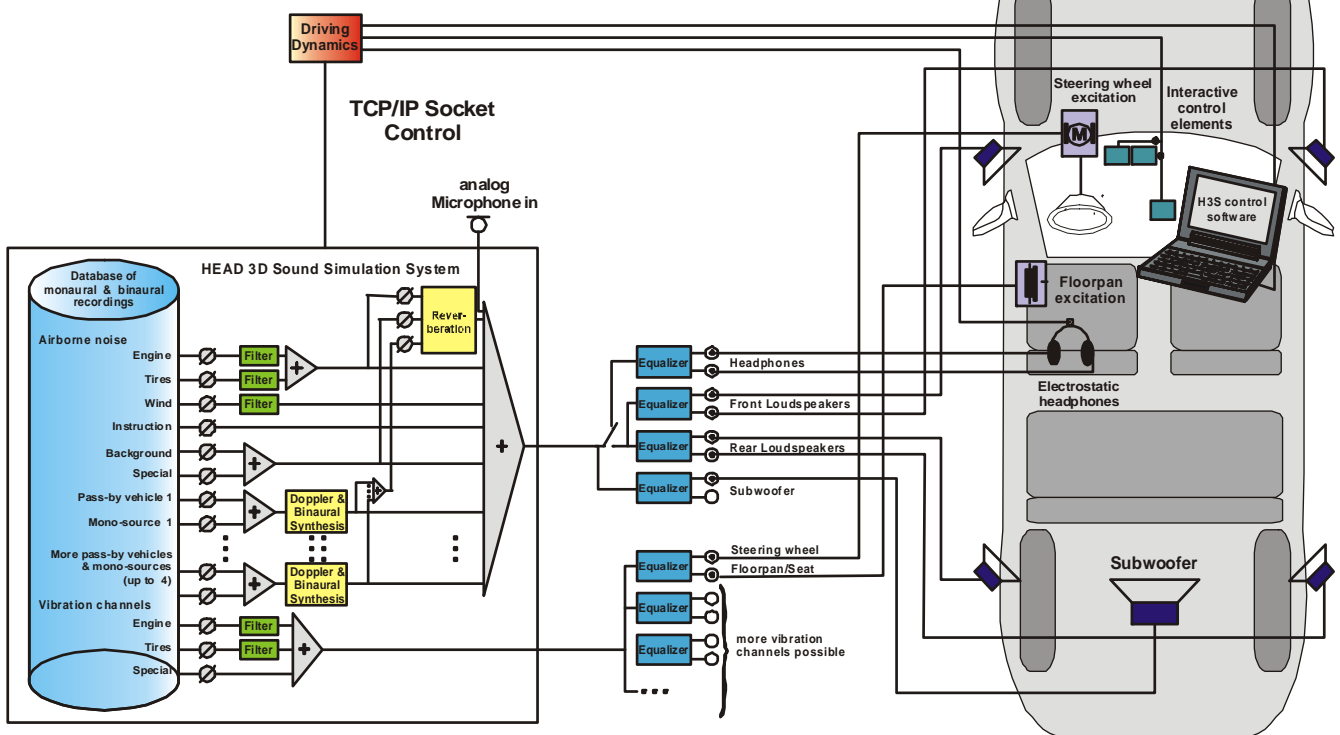
H3S in a stock vehicle during a real drive



H3S as subsystem in the stationary driving simulator

Simulations can be performed not only while driving, but also with switched off engine in the standing vehicle (stationary simulation).

The hardware equipment required for the operation of H3S can be installed with little effort in any stock vehicle.

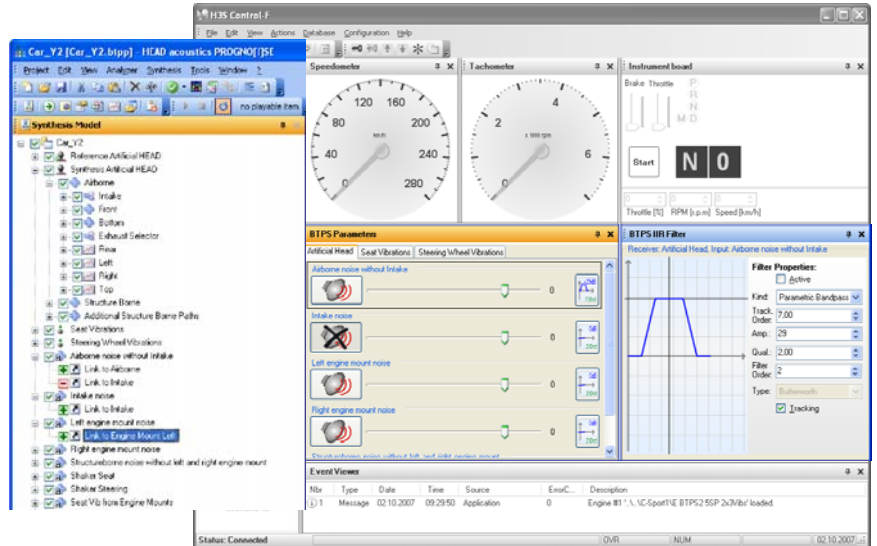


The schematic (H3S and SoundCar) shows how H3S links the sounds stored in the database together, processes them and plays them back. The filtering possibilities for engine and wind sounds as well as the playback of recorded vibrations are optional modules.

## H3S and PROGNO[I]SE

H3S has a PROGNO[I]SE interface allowing the simulated sounds of a binaural transfer path analysis (BTPA) to be transferred into the H3S software, where they can be played back and evaluated interactively.

Up to ten critical paths, which can be individual components or components combined into a group, can be manipulated individually (muting, level modification, filtering), the result is played back separately or included in the synthesis of the complete soundscape.



The synthesized sounds of PROGNO[I]SE can be easily transferred to the H3S-Software, where they can be played back and evaluated interactively

### **Delivered Items:**

#### **H3S base software**

- HEAD 3D Sound Simulation System (H3S), Setup DVD
  - H3S Control
  - H3S Prepare Engine Data
- H3S Monitor (Code 7003)
- H3S Editor (Code 7004)
- Documentation (PDF)
- Dongle

### **Optional:**

#### **H3S TP1 (Code 7008)**

#### **H3S real-time switching between different engines**

Switching between up to 10 different, previously loaded engine sounds in real time during the running simulation.

#### **H3S TP2 (Code 7009)**

#### **H3S real-time filtering**

Channel-selective real-time filtering of airborne and structure-borne sound of engine, wind and tires. Up to 20 filters can be activated simultaneously (e.g. variable filters, highpass, lowpass, bandpass and parametric filters, controlled by RPM, order or speed).

Order Generators (up to 200 orders)

(MS Excel is required for reading the RPM- or order-controlled filter curves.)

#### **H3S TP3 (Code 7010)**

#### **H3S playback and vibration channels**

Authentic playback of recorded vibrations via an additional digital sound card. Vibrations are controlled depending on the driving situation.

#### **H3S TP4 (Code 7011)**

#### **H3S driving dynamics module**

Driving dynamics model for stationary simulator. User can choose between conventional or automatic transmission (with Tiptronic). Via MS Excel, the driving dynamics model can be configured individually.

(MS Excel is required for the individual configuration of the driving dynamics models.)

(Two password-protected example files are included.)

#### **H3S TP5 (Code 7012)**

#### **H3S interface for PROGNO[I]SE**

A specific analysis, modification and simulation of the sound transfer paths is possible with the expansion module for PROGNO[I]SE.

Up to 10 critical paths can be examined individually (individual paths can be muted, amplified / attenuated or modified with various filters), for example to determine the effect of individual vehicle components on the complete soundscape.

### **System requirements:**

- Windows XP (32 bit: Professional - Languages: US / Western European)
  - ≥ 1.5 GHz Pentium
  - ≥ 1 GB (RAM)
- or
- Windows® VISTA™ (32 bit and 64 bit: Business, Ultimate - Languages: US / Western European)
  - ≥ Core2Duo Processor 2 GHz
  - ≥ 2 GB (RAM)
- or
- Windows® 7 (32 bit and 64 bit: Professional, Enterprise, Ultimate - Languages: US / Western European)
  - ≥ Core2Duo Processor 2 GHz
  - ≥ 2 GB (RAM)
- Sound card DSB (Code 2405)

### **Network-compatibility**

The software components H3S, H3S Control, H3S Prepare Engine Data and the H3S Editor are network-compatible. Just a single dongle is needed to make these software options available for different users.