Press Release

For a Flawless Riding Experience

Whisper-Quiet Bicycles: Fraunhofer IWU and Partner Pool Expertise for Premium E-Bikes

Rattling, clicking, and high-frequency vibrations not only compromise comfort; they fundamentally define the perceived quality of a premium e-bike or high-performance cycle. To address this, Fraunhofer IWU and its development partner are offering e-bike manufacturers a joint testing and development program. At Fraunhofer IWU Dresden, a newly developed acoustic test rig housed in an anechoic chamber enables high-precision acoustic investigations. This infrastructure allows e-bike manufacturers to bring their products to market maturity much faster.

Acoustics Heavily Influence Purchasing Decisions

Cycling enthusiasts value reduced noise and vibration as a sign of quality. A quiet, smooth ride and cohesive sound profile define the experience. Rattling, clicking, or tonal noises are noticed as negative traits. Noise optimization is most successful when sound sources and their effects are identified early. This allows improvements to be made during development. The partnership combines test rig technology with expertise in measurement and analysis. Manufacturers can now evaluate distracting noises at the prototype stage and eliminate them before series production.

No "Late Surprises" Thanks to Realistic Testing Conditions

While traditional test rigs focus primarily on durability, load changes, or structural strength, the new acoustic test rig specifically targets noise generation and transmission. It has been developed by EMEC Prototyping GmbH and validated by Fraunhofer acoustics experts for measurement accuracy and reproducibility. It allows for the simulation of real-world riding situations, such as defined excitations from the ground, load changes in the drive unit, or targeted vibration inputs. This makes it possible to examine both complete bicycles and individual units (e.g., the drive/drivetrain); even a real rider can "pedal hard" during the test. High-resolution measurement technology and sensors (airborne and structure-borne sound), along with a decoupled test environment, help detect even subtle acoustic phenomena and precisely assign causes such as dynamic excitation, resonance, or design flaws.

Reliable Data for Development, Benchmarking, and Pre-series Production

The test rig provides robust, comparable data for development support, benchmark analysis, and pre-series investigations. Fraunhofer IWU applies its acoustic methods along the entire causal chain—excitation, transmission, and sound radiation—to manage not only the symptoms but also the relevant generation and transmission mechanisms.

Measurements That Reflect the Actual Riding Experience

For manufacturers, it is crucial that measurements are not only technically accurate but also interpretable and customer-oriented. Therefore, depending on the development goal, additional methods can be utilized:

- Binaural Head Technology: Measuring airborne sound at the rider's position using a dummy head. These measurements capture noise exactly as humans perceive it with two ears (binaurally)—spatially, as if a person were present in the sound field.
- Pass-by Positions: These can be useful for product comparisons and evaluating exterior noise levels.
- Sound Power Determination: Possible according to individual or standardized specifications.
- Vibration Measurement: Performed on components and frames to evaluate vibration levels.

The acoustics team at Fraunhofer IWU Dresden welcomes inquiries from interested e-bike manufacturers, component suppliers, and other players in the field of electric mobility.

Dynamic Forces as the Cause of Distracting Noises

Noise doesn't happen by accident—it is often triggered by dynamic forces from the electric motor or the gearbox, which are introduced into the frame and components via interfaces and radiated as airborne sound. Instead of time-consuming trial-and-error correction loops, Fraunhofer IWU relies on scientifically sound methods based on **Sound Source Characterization**:

Transfer Path Analysis (TPA): A method used to analyze how unwanted noise and vibrations travel from their source to a receiver (e.g., the cyclist's ear) by identifying and quantifying the various transmission paths (airborne and structure-borne).

*** NVH (Noise, Vibration, and Harshness):** The analysis of audible and tactile vibrations that affect the riding experience. For electric bikes, the focus is on specific frequencies from electric motors and gearboxes that must be optimized for acoustic comfort.

Fig. 1 The acoustic test rig, developed by EMEC Prototyping GmbH and validated jointly with Fraunhofer IWU, during tests with a high-end e-bike at Fraunhofer IWU Dresden.
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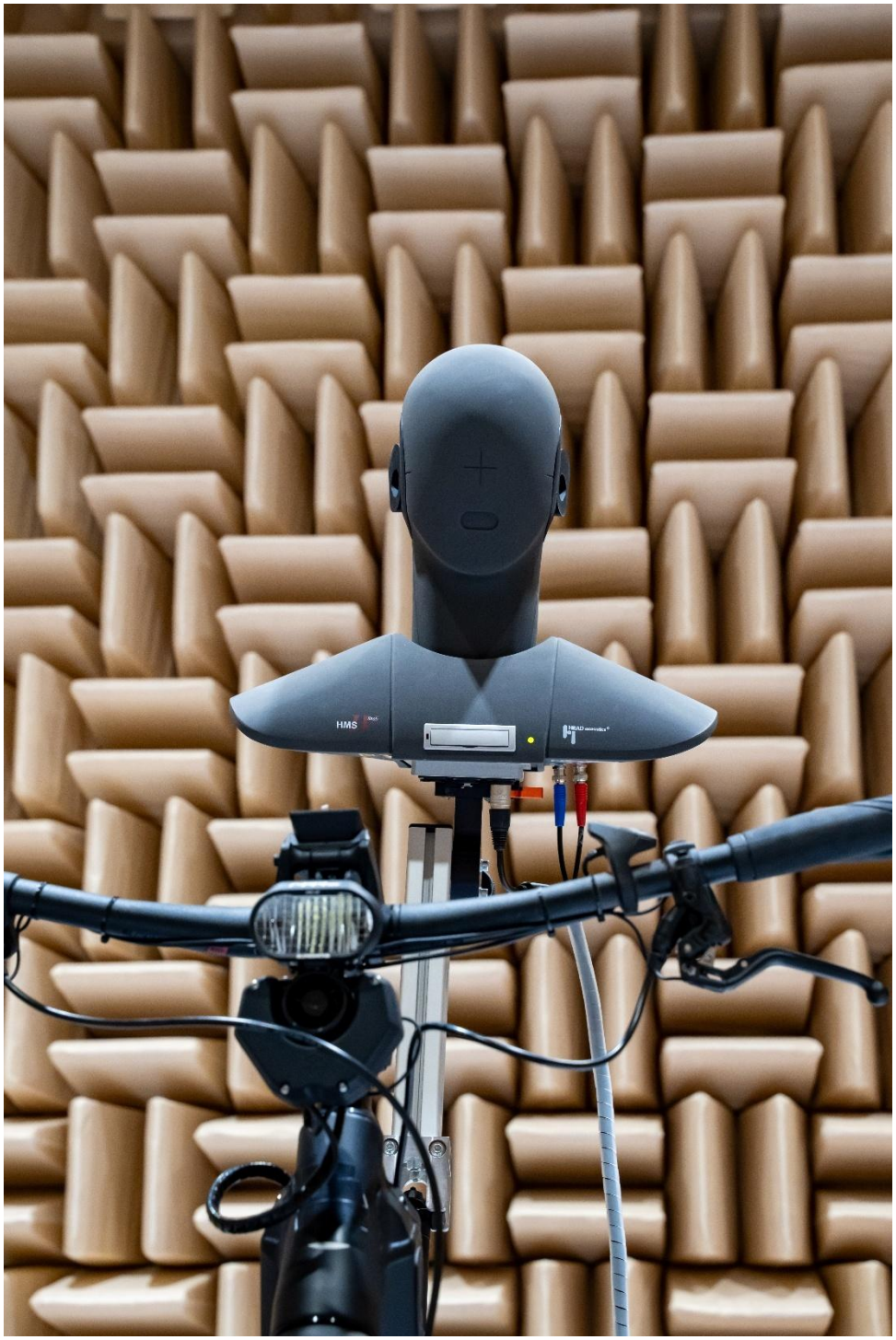

Fig. 2 Binaural measurement using a dummy head. © EMEC

Fig. 3: Dr.-Ing. René Beckert, Managing Director of EMEC-Prototyping GmbH, conducts tests under real driving conditions to achieve practical and reliable results. © EMEC

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