Planetary Centrifugal Pendulum Absorber (pCPA) – New type of Centrifugal Pendulum Absorber for Applications in Highly Downsized Hybrid and Range Extender Combustion Engines

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Abstract: Currently automotive technology is moving more and more from conventional combustion engines to hybrid and fully electrical power drives. The low battery capacity of conventional batteries causes small operating ranges and constrains electrical support in hybrid vehicles.

One possibility to increase the range of electric cars on top of energy recuperation during braking operations is to generate electric energy directly using a generator driven by a range-extender combustion engine. Continuous reduction of emissions and fuel consumption forces the application of supercharged combustion engines with low numbers of cylinders. However, this causes undesirable torsional vibrations even in hybrid and range extender concepts.

The pCPA-concept developed and engineered at the Technische Universität München (TUM) is a new type of pendulum-type absorber suitable for applications in highly downsized and downspeeded conventional powertrains as well as for hybrid and range extender combustion engines. The pCPA enlarges the effective range of pendulum-type absorbers and improves the effectiveness and acoustical performance particularly in transient load states and in operational areas with low rotational speeds.

Keywords: pCPA, planetary centrifugal pendulum absorber, torsional vibrations, automotive powertrain, range extender, combustion engine, plug-in-hybrid vehicle with auxiliary power unit (APU).

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5.1 Current Trends in Automotive Technology

Rising fuel prices and tightened emission regulations lead to increased development of more efficient drives, especially in vehicles.

The development trend of fuel- and diesel-powered vehicles is towards low-emission hybrid vehicles and to purely electric driven vehicles with highly downsized and downspeeded combustion engines. [1]

5.1.1 Downsizing and Downspeeding

Main topics in research and development of combustion engines are Downsizing and Downspeeding, targeting high engine power combined with lower fuel consumption and lower emissions.

An outlook for 2020 regarding powertrain technologies (Figure 1) shows that the number of combustion engines will increase due to powertrains including hybrid and range extender combustion engines.

Downsizing results in highly turbocharged combustion engines with low swept volume and less number of cylinders. Engine torque and power is at least equal to conventional engines (Figure 2).

Downspeeding concepts aim shifting engine operating ranges to low speeds and higher loads increasing the efficiency of combustion engines.

![Figure 1: Outlook for 2020 regarding powertrain technologies [2]](image-url)