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Optical signal transmission solutions for electromobility and renewable energies in favor of a low carbon future

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Summary:
Wind energy and electromobility have the biggest share each in the production of renewable energies and a carbon-free use of them. Essential for very important basis for the transition to a low-carbon society the technical side of optical solutions shown in an optimized communication to power analyzers by optical remote probes and its versatile advantages with fiber optic technology as well as an optical pantograph monitoring solution for optimization of rolling stock is explained in here.

Keywords: electromobility, renewable energy, wind energy, electric motor, mechanical power, electrical power, efficiency, torque transducer, current transducer, power analyzer

Introduction

At the end of 2024, the UN Climate Change Conference took place in Baku, Azerbaijan showing there is no alternative to a world of 100 % renewables [1]. One of the results was that wind energy on the one hand and electromobility on the other respectively represent most important contributions to securing the global climate.

To secure further developing progress in these new technologies, solutions must be thought, better in comparison with current methods.

Resulting technical requirements

The Helmholtz Research Field Energy (HRFE) sees the task of developing a science and technology driven roadmap for energy research, to which we see ourselves as equally committed [2]. In several publications aspects of that progress has been described in detail. Increasing size of by wind turbines, makes torque generated rise to dizzying heights in the MN·m range. With the trend to offshore wind turbines the midterm horizon is nominal of 20 MN·m, necessary to be traced back as well [3;4], we offer reference standards. In this article now, the signal flow from sensors to DAQ should be the special topic.

Optical solutions vs electrical once

One of the most significant differences between optical interconnects and electrical interconnects is the speed and distance at which they can transmit data. Optical interconnects use light to transfer data, which allows for faster data transmission speeds. At the same time, they consume less power than the equivalent electrical interconnections and are more suitable for autarch or mobile solutions [5]. However, in the following solution advantages beyond that come into play.

Description of the new solution

In Electric Power Train testing for electromobility applications the parameters of the electric motor need to be investigated. Voltage measurement can be realized quite easily, current measurement needs special attention.

Current measurement is carried out by using the generated magnetic field, what has the specific advantage of being a non-contact i.e. isolated current measurement, so that the primary circuit does not need to be interrupted with the insertion of a lossy component like a shunt.

Fig. 1: Fluxgate current transducer HBK CTS200ID, manufactured by DaniSense, DK, Source: HBK

In an electric power test stand usually long cables from the current transducer are exposed to high voltage and often EMC problems. In case the new fiber optic remote probes feeding signals it into a power analyzer, this is not the case.

Fig. 2: Fiber optic remote probes for voltage (a) and current (b), for current optionally with integrated power supply (c)

The compete setup of an Electric Power Train test stand with fiber optical fusion probes and yellow optical cables to the power analyzer is shown below, allowing uncompromised safety and with shorter cable lengths to prevent reflections too [6].

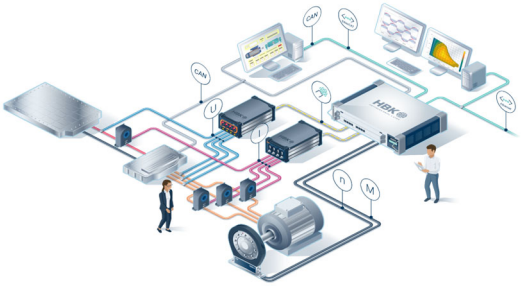

Fig. 3: Electric Power Train testing for electromobility with fiber optical fusion probes, saver and still more simple set-up

Integration into other optical solutions

The shown remote probes offer all the advantage of fiber optic technology to optimize communication ways to the power analyzer. However, their benefits can be further enhanced by combining them with other offers, complementary to other optical solutions HBK offers in the applications. So, for many years HBK offers already the HBK optical Structural health monitoring for wind energy applications [7].

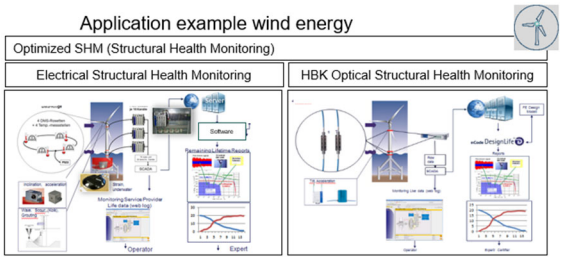

Fig. 4: HBK optical Structural health monitoring for wind energy applications

An example of a completely fiber-based measurement chain in electromobility is the newly developed pantograph optical monitoring providing optimized pick-up safety for rolling stock. High-voltage pantograph overhead-line monitoring can acquire optical sensor information in parallel to vehicle bus signals and position sensing (GNSS) allows you to build a graphical map of your infrastructure.

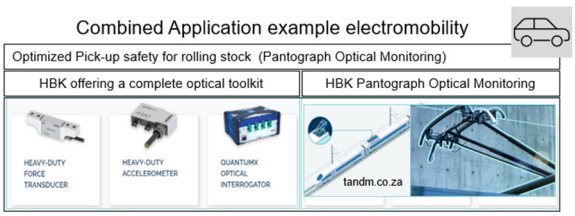

Fig. 5: HBK Optical pantograph monitoring solution for optimization in rolling stock

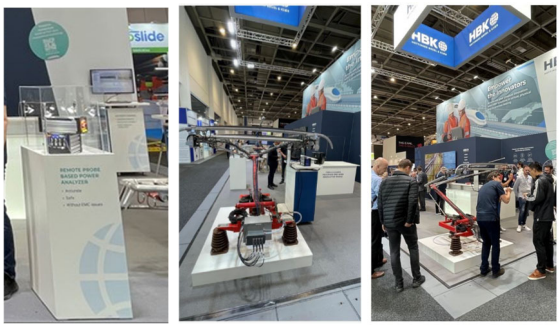

Fig. 6: Optical remote probe and optical pantograph solutions demonstrated

Both new optical solutions, the remote probes as well as a pantograph live demo have been presented at “InnoTrans 2024”- the leading international trade fair for transport technology, in September 2024 in Berlin, Germany (Fig. 6), and received great interest. We have more solutions in the pipeline and all the new solutions will be explained in detail in the oral presentation.

Conclusion

It could be shown that new optical solutions are not only superior in speed and distance, but it is over all the safety with which they are able to transmit signals despite of high voltages and harsh environments. The advantages will be presented in detail in the full paper and in the oral presentation.

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