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Global Research Trends in AI-based PHM (Prognostics and Healthy Management) and CPS (Cyber Physical System) Technologies in the Turbomachinery

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Abstract. The current average Internet speed is more than 10,000 times faster than the early days of the Internet in the 1990s, and the speed of GPUs and accelerators is beyond imagination at 5 PFLOPS (petablops; a term combining the prefix peta, which indicates 10 to the power of 15, and flops, a unit of computer performance, and performing 1,000 trillion floating point operations per second). The processing speed of this data and the computational speed of the processor to implement it are combined with artificial intelligence algorithms, and we are encountering technologies from another world that are different from those of just 10 years ago.

The academic basic concept of past health prediction diagnosis and management is rapidly changing to the expanded PHM technology of the aforementioned AI-based technology combination, and this scalability not only saves time and costs, but also increases its accuracy. In particular, ROM (Reduced Order Model) technology is an essential element in mathematical modeling and simulation, and can efficiently describe and analyze complex systems with high-dimensional state spaces. In other words, ROM can change the prediction based on the design without performing a separate M&S every time the design changes by simply changing the variables, so it is very useful for CAE or CFD applied to the design of turbomachinery, and it is a tool that can save costs and time in experiments that actually cost a lot of money and improve reliability, and the direction of research is changing.

Also, “Digital Twin” is sometimes used interchangeably, but “Cyber Physical System” technology implements the physical status in the real world to the cyber status, and “Connective Technology” technologies that can synchronize them are very important. Through “Digital Transformation,” it is possible to reduce the cost (time) of the target and increase insight, and it is evaluated as a technology that can increase its own value by combining it with the aforementioned AI technology.

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