

## Consideration of the Behaviour of a Wind Turbine Wake Using High-Fidelity CFD Simulations

Koichiro Shibuya<sup>1\*</sup>, Takanori Uchida<sup>2</sup>, Masaki Inui<sup>1</sup>, Zhiren Bai<sup>3</sup> and Yoshihiro Taniyama<sup>3</sup>

<sup>1</sup> Engineering and Technology Development Department, Wind Power Business Unit, Machinery & Infrastructure Business Headquarters, Hitachi Zosen Corporation, 7-89, Nankokita 1-chome, Suminoe-ku, Osaka 559-8559, Japan, shibuya.k@hitachizosen.co.jp  
(<https://www.hitachizosen.co.jp>)

<sup>2</sup> Research Institute for Applied Mechanics (RIAM), Kyushu University, 6-1 Kasuga-kouen, Kasuga, Fukuoka 816-8580, Japan, takanori@riam.kyushu-u.ac.jp

<sup>3</sup> Mechanical Engineering R&D Department, Energy Systems Research and Development Center Toshiba Energy Systems & Solutions Corporation, 2-4 Suehiro-cho, Tsurumi-ku Yokohama-shi, Kanagawa 230-0045, Japan, zhiren1.bai@toshiba.co.jp

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During a wind turbine is in operation, a wake is created behind the wind turbine and it reduces the power generation and lifetime of a wind turbine located downwind. Therefore, it is important to accurately predict the effects of wake in order to assess the feasibility of a wind farm. Hitachi Zosen Corporation has been conducting joint research with the Institute of Applied Mechanics, Kyushu University and Toshiba Energy Systems & Solutions Corporation since 2018 to develop a versatile wake model [1]. In this paper, we report the three-dimensional structure of the unsteady wind turbine wake and the behaviour of the wake when wind direction variation is given to the inflow wind, obtained by numerical simulation of the Omonogawa wind power plant conducted during the development process.

We conducted numerical simulations to reproduce wind turbine wake using the “RIAM - COMPACT” real urban version [3]. The following findings were obtained from the simulation results. Inside the wake in 1D downstream of a wind turbine, a flow field that rotates in the direction opposite to the blade rotation direction occurs. There is no significant difference in the flow field of the wind turbine wake between the up-wind type and the down-wind type. In 5D downstream of a wind turbine, the vertical distribution of the mainstream velocity component is almost the same regardless of the power of the inflow profile in the swept area of the wind turbine. When the inflow wind has a wind direction variation defined by a sinusoidal function with a maximum value of 10 degrees, the wind turbine wake is quite diffuse and the results of its vertical profile are in good agreement with the field measurement results by a vertical profiling lidar.

### REFERENCES

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