Development of wake centerline detection algorithms for the study of wind turbine wake meandering[1] NICOLAS COUDOU, Université catholique de Louvain, Université de Mons, von Karman Institute for Fluid Dynamics, LAURENT BRICTEUX, Université de Mons, JEROEN VAN BEECK, von Karman Institute for Fluid Dynamics, PHILIPPE CHATELAIN, Université catholique de Louvain — The low-frequency oscillatory motion of wind turbine wakes, also known as wake meandering, is crucial in wind farms as it increases fatigue loads on downstream turbines. The study of this phenomenon requires, as a first step, the determination of the position of the wake. The wake centroid tracking proposed in this work is based on the computation of the wind ipower inside a disk of a diameter equal to the rotor diameter and shifted in a cross-flow plane. The wake center corresponds to the disk position for which the available power is minimum. Mathematically, it consists in locating the maximum of the convolution between the power available in the flow and a masking function. The wake centerline can then be obtained by repeating this technique in each cross-flow plane in the wake of a machine. This method being sensitive to strong local minima of wind speed occurring for high level of inflow turbulence, an improved method based on a 3D convolution is proposed in this work. These techniques are applied to the data obtained from Large-Eddy simulations of the NREL 5-MW wind turbine subjected to synthetic turbulent inflows. The computations were performed with a vortex-particle mesh code, the presence of the wind turbine rotor being accounted for through immersed lifting lines.

Nicolas Coudou
Univ catholique de Louvain, Univ de Mons, von Karman Inst, Fluid Dynamics