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THE GRAPHICAL IMPLEMENTATION OF FAST 8 FOR OFFSHORE WIND TURBINE STRUCTURAL ANALYSIS SOFTWARE X-SEA 2.0

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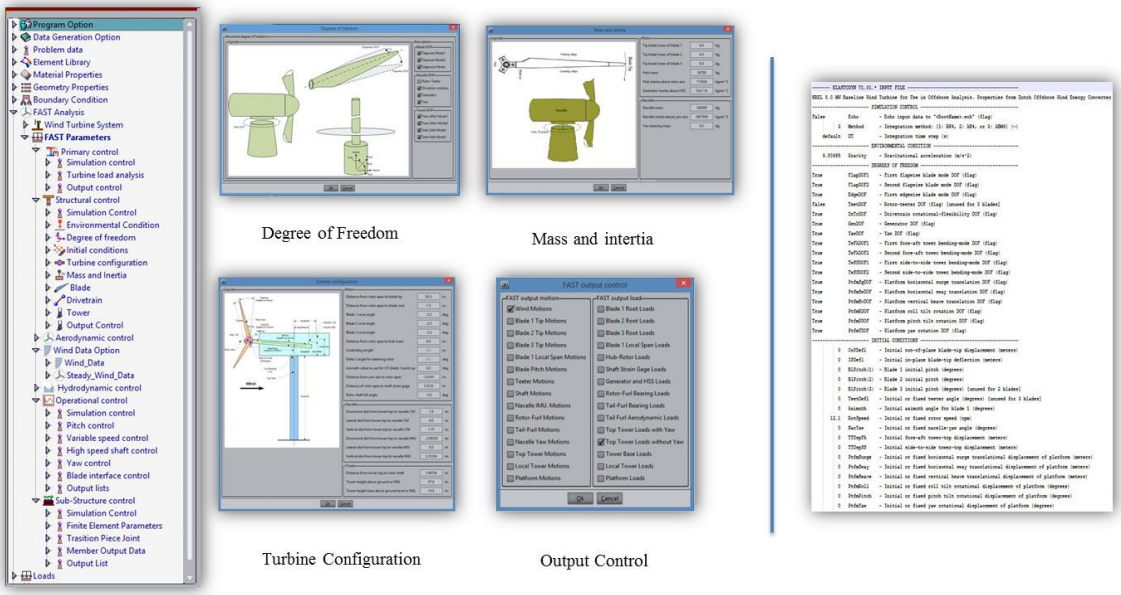
Abstract. The 3D finite element analysis software X-SEA has been developed to solve the offshore structures including oil & gas platforms and wind turbine farms. The current version of X-SEA combining with the pre& post Processors of FAST 8 includes the results of extensive research and development base on finite element program XFINAS, which was originally developed in Imperial College, London. The solution of the X-SEA ranges from the simple static, to highly advanced dynamic analysis applied to the offshore structures. In this research, three types of the offshore wind turbine platforms are used to compare and validate the X-SEA with FAST 8 and original FAST 8 program. The results of XSEA with FAST 8 show the six components at top of tower are identical with the original FAST program.

1 INTRODUCTION

The 3D finite element analysis software "X-SEA" has been developed to carry out the analysis and design of the offshore structures including wind turbine farms [1]. The solution of X-SEA ranges from simple static, to highly advanced non-linear dynamic analysis. The user-friendly graphical interface of X-SEA and FAST 8 is developed using the pre/post processor software, GID 12 [2]. The X-SEA can be applied in offshore project including: non-linear structural dynamic analysis; due to wave, wind, current, seismic loads, fatigue life, transportation, and lifting. The X-SEA can model any platform of offshore steel and concrete structures with the calculation of tendon in pre-stressed concrete. In the present version, X-SEA combining with FAST program [3] has been developed and applied for the load combination of wind turbine support structures. The results from the extensive research and development can be applied in the onshore and offshore wind turbine platform structure. The main purpose of this research is to present the pre & post processor of the FAST 8 by using the FE software X-SEA. The motion and loading analyses carried out from aerodynamic module are implemented in the X-SEA and validated with three types of platform structure produced by NREL report [4].

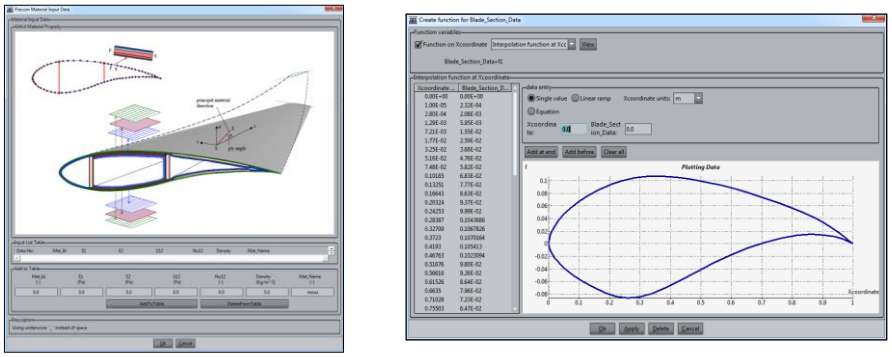
2 GRAPHICAL IMPLEMENTATION

The finite element package FINAS was developed in Imperial College. At present, the X-SEA (An extended version FINAS) for the general non-linear dynamic analysis of offshore structures has been developed by Prof. Ki-du Kim in Konkuk University. The current version of the X-SEA combining with FAST program is applied for the load combination with advanced graphics of windows in a single program. The format of data input of original Fast 8 is based on the text foramt but the format of the X-SEA data input is based on the graphic system with help pictures in figure 1. Those pre& post processors developed conveniently assist engineers to reduce the computational times and cost. The pre& post processors of the additional program such as Tubsim [5], IEC [6], and PreComp [7] has been also included as shown in figure 2.

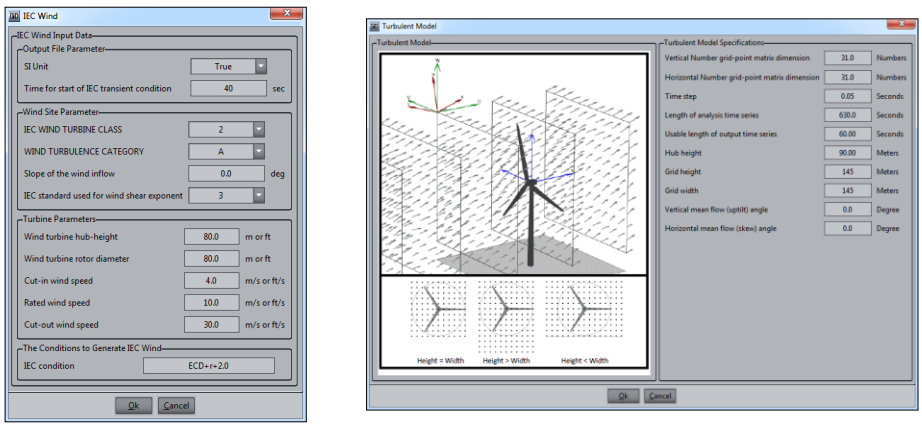


(a) Graphical interface of FAST 8 in X-SEA (b) Original FAST data input

Figure 1: Graphical Interface Implemented into the X-SEA and Original FAST Data

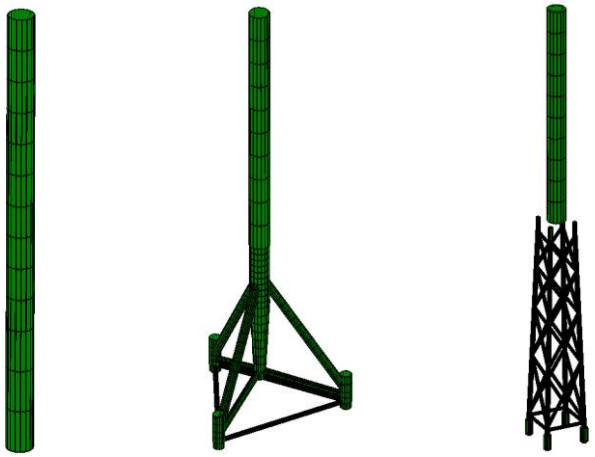


(a) PreComp window menu



(b) IEC and Tubsim window menu

Figure 2: Addtional wind turbulence and blade design program of FAST 8



(a) Monopile (b) Tripod (c) Jacket

Figure 3: NREL model of Wind Turbine Offshore Platform using X-SEA

3 RESULTS

In this section, the dynamic response of Monopile, Tripod and Jacket structures in figure 3 was modeled to validate the turbine loading. The same geometries and properties of NREL [3] 5-MW turbine are used to investigate the six componets of motion on the top of tower.

The computed results from the X-SEA with FAST 8 and original FAST 8 show that the motions and six componets of loads on the top of the tower loads from three types of platform are identical with those of original FAST 8 program in figure 4.

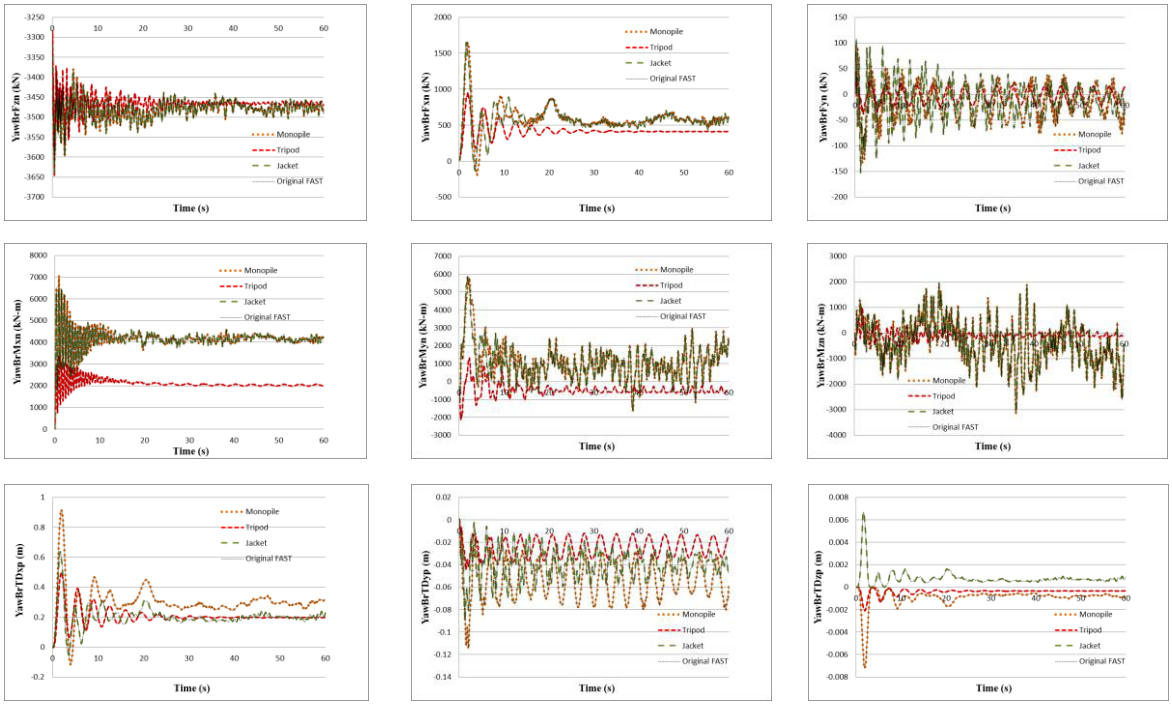


Figure 4: Motion and Six components of loads on the top of tower

4 CONCLUSIONS

The X-SEA with the Fast 8 has been developed based on the structural analysis software XFINAS. The solution of the X-SEA ranges from simple static, to advanced nonliear dynamic analysis of the offshore structures. And the user-friendly graphical interface of the FAST 8 has been also developed using the pre/post processor software, GID 12 and X-SEA. The pre and post processors of the FAST 8 implemented into X-SEA is easy to use as an independent program in X-SEA or the dependent program on X-SEA to carry out the structural analysis of wind turbine support structures with automatic load cases. The X-SEA with the Fast 8 allows the engineers easy to solve all the problems on the wind turbine offshore platform possible in a single program without using other programs.

ACKNOWLEDGEMENT

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