**Abstract for 10th World Congress on Structural and Multidisciplinary Optimization (WCSMO-10)**

**Presentation Title:** Multi-Objective Structural Optimization of Wind Turbine Tower and Foundation Systems using Isight: A Process Automation and Design Exploration Software

**WCSMO Topic Area:** Applications in Industry

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**Abstract:**

Currently, wind turbine towers are being built to increasing heights in order to tap into higher and more consistent winds available at these heights. Additionally, increasingly large wind turbines are being deployed atop these towers in order to capture more energy. This trend of larger turbines being deployed at greater heights makes obtaining the most efficient and safe, or optimal, designs of the structures that support them ever more important. Towards this goal, the present work formulates the design of an integral wind turbine tower and foundation system as a multi-objective optimization problem using the process automation and design exploration software Isight. Specifically, a continuous variable optimization problem is formulated for the design of a wind turbine support structure consisting of a 130-m hybrid pre-cast concrete and tubular steel tower supported by a gravity based foundation. A geometrically non-linear transient finite element analysis of the support structure is solved at each optimization iteration using Abaqus. This problem is multi-objective in nature with an ideal design being one that both minimizes costs and maximizes structural stiffness to reduce vibrational wear on turbine components. Therefore, a composite objective function is developed that minimizes raw material costs and maximizes stiffness. The physical dimensions of the wind turbine support structure are taken as design variables. Design criteria such as buckling of the tower wall, limits on tower top deflection and rotation, limits on the natural frequency of the tower and foundation system, bearing capacity of the foundation, stiffness of the foundation, and foundation overturning moment are evaluated in Mathcad at each optimization iteration and converted to optimization constraints by Isight. Results obtained show that the design of a wind turbine tower and foundation system can successfully be formulated as an optimization problem and that the optimal design depends heavily on the weights assigned to the individual components of the objective function. Therefore, an Archived based Micro Genetic Algorithm (AMGA) within Isight will be used to solve the problem and to construct a Pareto front showing the set of Pareto-optimal designs. It is anticipated that this work will clearly illustrate and quantify the trade-off between maximizing stiffness and minimizing cost while providing the engineer with the full set of optimal designs. Furthermore, this work as a whole shows that optimization can be applied at the detailed design level by incorporating detailed design criteria and advanced analyses into the optimization process.