

# Designing a Rhino® Plug-in for Isogeometric Analysis

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## Overview

Engineers and analysts do not have the required tools to communicate:

- . There are currently no options for FEA in CAD.
- . The CAD-to-FEA integration introduces error.

One solution that has been shown to significantly reduce error is the use of isogeometric analysis (IGA) on designs.

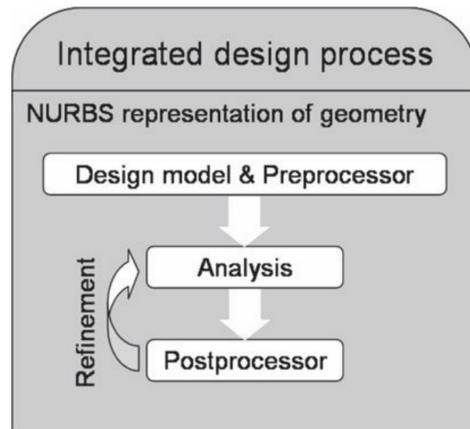


Fig 1. Design process of CAD and CAE integration

Schmidt, R., J. Kiendl, K. U. Bletzinger, and R. Wüchner. "Realization of an Integrated Structural Design Process: Analysis-suitable Geometric Modelling and Isogeometric Analysis." *Computing and Visualization in Science* 13.7 (2011): 2. 14 Jan. 2011. Web.

## Motivation

Isogeometric analysis is used for a more precise analysis of objects:

IGA relies on the use of NURBS which are accurate representations of curves.

Develop a Rhino® plug-in that will perform IGA on a CAD program.

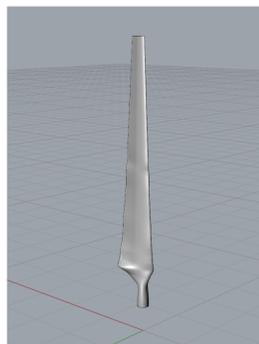


Fig 2. Rhino® model of S809 wind turbine

## Materials & Methods

**C#** is the main programming language of the isogeometric analysis plug-in:

- . Can be compiled on a wide range of computer platforms.

**Rhino®** is a 3D modeling software for producing curves and surfaces:

- . Only CAD software that supports user developed plug-ins.

**Grasshopper™** is a visual programming language plug-in:

- . Allows members to engage in the development process in a non-trivial manner to produce faster prototyping.

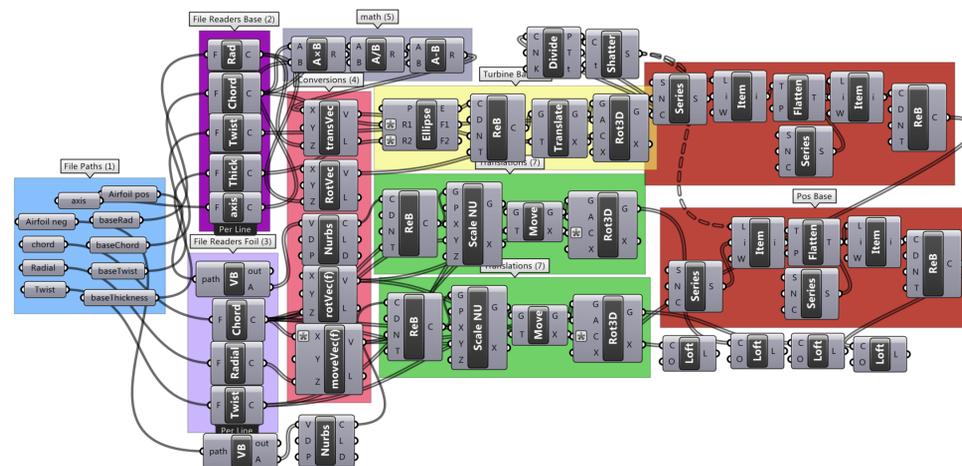


Fig 3. Grasshopper loop function for S809 wind turbine.

## Results

A successful script was created to design a wind turbine blade using Grasshopper™. The S809 airfoil was used for a design because this airfoil incorporates all important functions within the program such as moving, scaling, and rotating. After programming the interface needed to be designed. The interface gives users the flexibility to have multiple cross sections of their desired object.

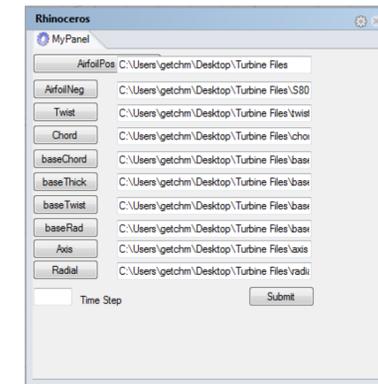


Fig 4. Sample plug-in interface

## Future Work

After creating the first version of the plug-in, many steps have to be taken to guarantee maximum user experience of the interface:

- . GUI development (design layout and interface changes)
- . Drag-and-drop functionality
- . Greater range of analysis options
- . User testing (Fitts' Law analysis)
- . T-spline analysis support
- . Brower-based IGA



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