TRC CONTINUATION PROPOSAL 2019-2020

Solid Modeler Implemented Rotordynamics

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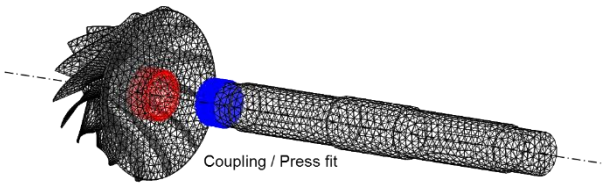
INTRODUCTION AND JUSTIFICATION

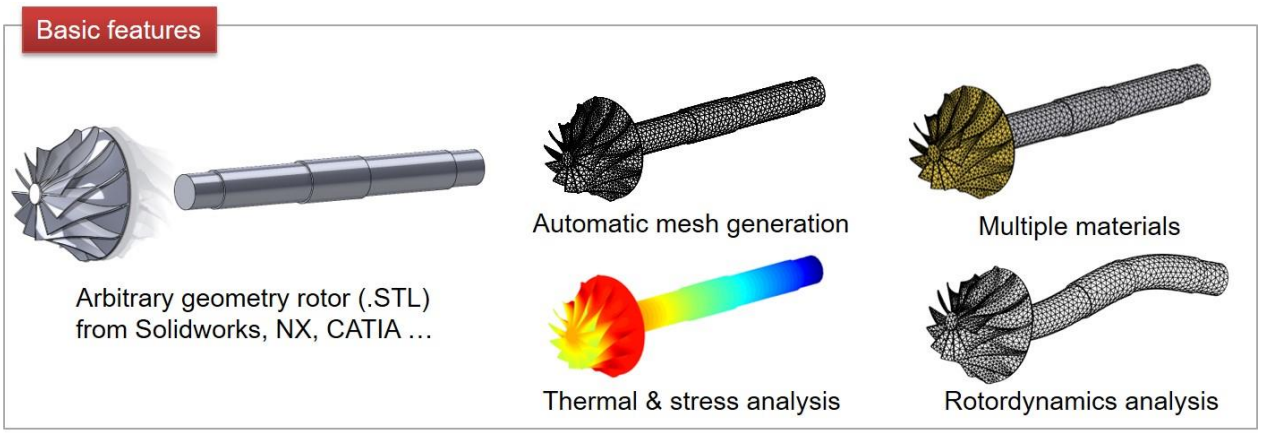


API, MIL, ISO and other standards insure that predicted rotordynamic response match those in the actual operating machinery, and are at acceptable levels. This requires high accuracy in predicting critical and instability onset speeds, with consideration of the rotor not being a single body, but instead an assembly of a shaft, disks, sleeves, thin blades, impellers, etc. with connections via couplings, press fits and so on. This may cause predicted natural frequencies and responses to significantly deviate from their measured counterparts, if a 1D beam-type, finite element model is employed for predictions. In these instances a 3D solid finite element model with accompanying rotordynamic analyses may be required to produce reliable predictions of critical speed, log dec, unbalance response, etc.

DELIVERABLES

Standalone 3D Solid Modeler TRC Software

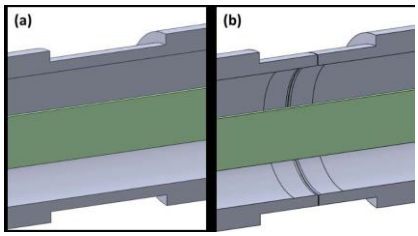
- Standalone 3D Solid Finite Element Rotordynamics software which runs under the EXCEL system umbrella without any other software (MATLAB, Fortran, ANSYS, …) required.
- Geometric input obtained from any solid model software outputs (Solid Works, Catia, …)
- Multiphysics solid finite element analysis (thermal/structural/rotordynamics) with arbitrary shape geometries (thin blades and etc.) with multiple materials and connections (coupling/press fits).
- Simulation environment for API 617 Level II analysis (destabilizing effect by interference fits)



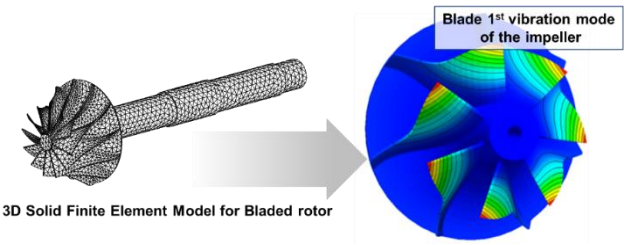
PROPOSED WORK

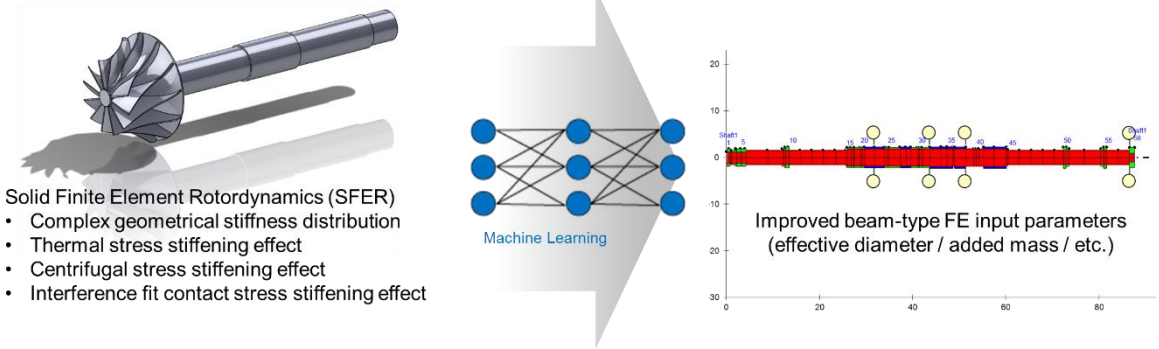
1) **Curvic couplings/Hirth joints and butt joint shafts with axial load contact model implemented rotordynamics**
2) **Preprocessing feature for beam FE codes (XLTRC^2) by the solid FE code**
   a. Automatic input-parameter-generation for beam FE code from solid models (.stl).
   b. Effective stiffness diameters for attached discs by the 3D Solid FE code
3) **Case study and user friendly simulation environment for bladed rotor-shaft assembly vibration analysis**
4) **Rotor-stator assembly modeling with full 3D Solid FE code by transfer function and hybrid solid/beam elements**
5) **Microslip at interference fits & shaft material hysteresis induced instability analysis (API 617 Level II)**
6) **Steady state imbalance response of asymmetric rotors**
7) **Aeroelasticity capability for blades**
8) **Enhance user interface/computation-efficiency/tutorials, and transfer the code into XLTRC^2**

Curvic coupling



Butt joint with tie-rod.
A. Rimpel IGTI GT2018-75101

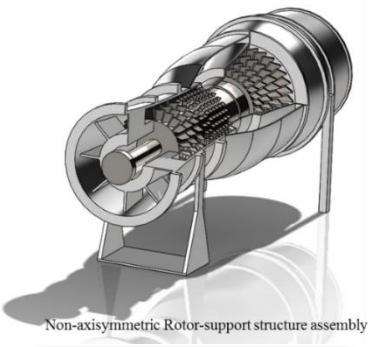




STATUS OF CURRENT WORK

Standalone Solid Modeler TRC Software

- A user friendly EXCEL User Interface based simulation environment for multiple arbitrary shaped disk-shaft assembly with multiple materials and with interference fits (contact model)
- Multiphysics analysis for thermal/structural/high-fidelity-rotordynamic analysis (natural frequencies, log dec, Campbell diagram, parametric instability and etc.)
- Advanced simulations for API 617 Level II analysis: shifting natural frequencies and destabilizing effect from interference fits



Rotor-stator assembly

BUDGET FOR 2019-2020

1 PhD student ($2,200/mo. Salary + $500/mo. insurance) × 12 months, Tuition and fees $13,000, computer, equipment, software license and supplies $4,600, **Total Cost: $ 50,000**