DESIGN INTEGRATION FOR SCREW COMPRESSORS

Lecture by:

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Part One

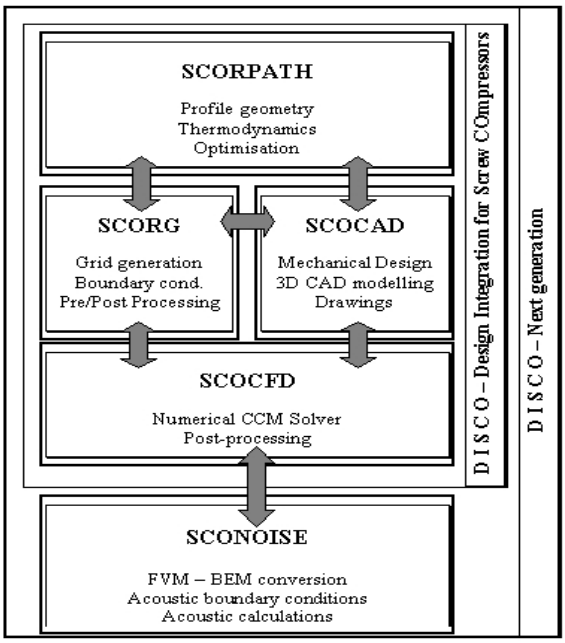
DESIGN INTEGRATION FOR SCREW COMPRESSORS-APPLICATION, EXAMPLE

Despite having all earlier mentioned programs already available, a great obstacle is to communicate between them. Being iterative, the concurrent design process often requires some phases to be repeated and the information between the software elements has to be interchanged several times.

The **D**esign **I**ntegration for **S**crew **CO**mpressors - DISCO is developed to manage geometry, thermodynamics and optimisation, boundary and operation parameters of a screw compressor in communication between the software components used in the machine design. The interface basically consists of five modules named SCORPATH, SCORG, SCOCAD, SCOCFD and SCONOISE. The organisation of DISCO is schematically given in Figure 1.

SCORPATH has been for a long time used for the design of screw compressors. It established its role as a basic design tool for screw compressors, mainly because of its ability to generate rotor profiles and to calculate thermodynamic behaviour of a screw machine quickly and accurately. Rotor profile generation procedure, applied in that software, generates the rotor either from the given curves on other rotor or on the rack using the envelope gearing method. Additionally, SCORPATH provides a calculation of forces on the compressor rotors, which then serve as a basis for further mechanical design of the machine.

A transfer of the compressor rotor and port geometry to a 2D CAD system out of SCORPATH is also possible. Since SCORPATH also calculates the tool profile, its results form a basis for the Computer Aided Manufacturing - CAM.



Calculation of the screw compressor performance based on the thermodynamic model and its ability to optimise the compressor geometry for the required working conditions are SCORPATH advantage compared with other similar packages.

SCORG – Screw Compressor Rotor Grid generator, is software that enables automatic generation of a 3D grid needed for calculation of fluid flow in the screw machine. As described in *Kovacevic et all (2002)*, the numerical mesh is generated by use of a specially developed boundary point distribution and adaptation procedure followed by an analytical internal point generation procedure. A hybrid method based on the Hermite transfinite interpolation is used for generation of internal points. By this means SCORG enables the 3D CFD pre-processing to be completed automatically using the data generated by SCORPATH. Additionally, only about ten other parameters are required to specify the required grid quality.

SCOCAD is a part of the design software package used to transfer the SCORPATH data to an arbitrary CAD system. These data are provided as the rotor 3D coordinate points,

ports and manufacturing tool data. Since these are automatically transferred to the CAD system, the 3D solid model can be built in a short time. Additionally, a parametric organisation of the data interchange through the external database such as excel, enables the design to be easily modified not only from CAD system itself but also from both the external database and SCOCAD environment. Being incorporated in DISCO, SCOCAD then enables the design changes to be introduced to other applications integrated in DISCO. In addition to that, it allows for the mechanical design aids such as the bearing selection routine in which the bearings are chosen from the built-in database and their life is calculated based on the bearing life theory. Similarly, the locking nuts, shaft keys and keyways, dowel pins, bolts and screws are selected from the database and automatically calculated to ensure effective performance of the designed machine. The 3D solid model obtained from the CAD system serves as a basis for rapid prototyping, while the automatically generated drawings are provided to support more conventional manufacturing methods.

SCOCFD is the part of the design interface which allows fast and accurate introduction of the compressor geometry and working parameters generated by SCORG and CAD system into the commercial Computational Continuum Mechanics – CCM, software. The computational grid of the screw compressor rotors generated by SCORG and the numerical grid of other parts of the compressor, the suction or the discharge chambers, which may be generated from either SCORG or CAD system, are imported into CCM software through the pre-processing file. That file also contains working parameters, information of the differencing scheme and other required solver information. A number of commercial Computational Fluid Dynamics – CFD, software packages are available on the market. Authors employed COMET of StarCD for the screw machine calculations. That code offers a possibility to calculate simultaneously both the fluid flow and solid structure by application of a Computational Continuum Mechanics – CCM principle. By this means all previous works on the generation and thermodynamic calculation as well as the design changes obtained through DISCO are fully integrated into an integrated tool for design of screw machines.

EXAMPLE