INVERSE DESIGN ON RETURN FLOW CHANNEL FOR MULTISTAGE RADIAL COMPRESSORS

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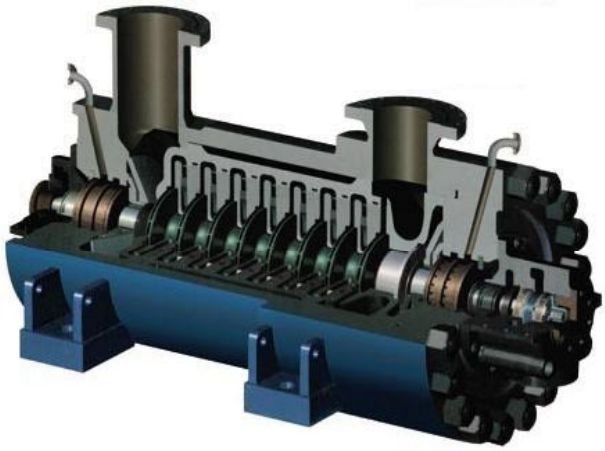
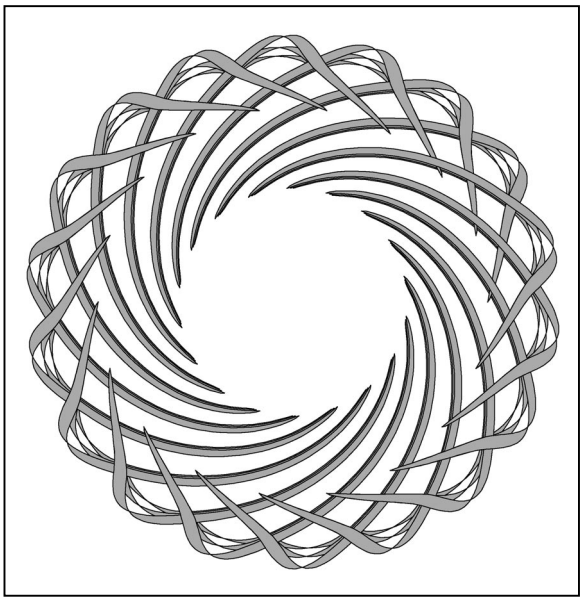


A typical optimisation problem for turbomachinery design is to improve the efficiency of the turbomachinery system while keeping the given design specifications, such as pressure rise or power recovery. Recently, the three-dimensional inverse design methods become practical in turbomachinery blade design because it is a powerful tool for blade design to control the blade loading distribution.

The return flow channel provides the connection and carries the flow between two stages of a multistage centrifugal compressor. Of course, deswirl vanes are indispensable between the inlet and outlet section, because usually the inlet flow angle, which comes from the impeller, is 70°-75° measured from radius and the downstream flow angle should be axial, for the next stage. Normally, the shape of this unconventional blade is unique, it is not possible to choose it from any catalogues.



During the design procedure, a couple of blade design method has been developed and realised by FORTRAN. The most relevant has been based on a zero circulation over the control surface, between two blades. The purpose of this theoretical investigation was to construct a 3D blade with the constant loading. The blade is extended over the cross over bend with expecting to decrease the losses. The next design step is to use an Euler based inverse design program, which has been developed at VKI, to make the blade as perfect as possible. Finally we should analyse the configuration by a 3D Navier-Stokes solver. In addition one has developed a system of programs for UNIX to help us to communicate between the different software. The results of viscous investigation show a perfect evolution from the first design to the latest one concerning the design parameters: the loss coefficient and pressure recovery factor. We can conclude that the extension of the blade over the 180^{o} cross over bend is an interesting idea to reduce the losses and increase the pressure recovery factor. If the losses are decreased it is possible to reduce the sizes of the geometry, which means saving with the expensive casing.