VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING TECHNOLOGY

of **Florian Fettweis**

The public defense will take place on **Wednesday 9th October 2024 at 5:00 pm** in room **D.0.08** (Building D, VUB Main Campus)

To join the digital defense, please click here
Meeting ID: 386 080 661 747
Passcode: YKegQ2

ACTIVE CLEARANCE CONTROL FOR SCREW COMPRESSORS: THE MACRO EFFECT OF MICRO POSITIONING

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Abstract of the PhD research

Screw compressors are widely used in various industrial applications for low to medium flows and pressures. Their efficiency is significantly influenced by leakage through clearance gaps within the compressor. The relationship between clearances, leakage, and efficiency has been challenging to validate experimentally due to the lack of precise and reliable methods. Active clearance control (ACC) has emerged as a potential method to enhance performance and validate the clearance-efficiency relationship of screw compressors. By actively closing the clearance gaps during operation, this intrinsic relationship can be examined beyond what can be achieved with currently used passive clearance control methods, such as specialized coatings, lubrication oils, and precise machining.

This study developed and tested novel compliant actuators for ACC, including hydraulic spacers for axial positioning, additive-manufactured rotor positioners, and casing-deforming inserts. A design procedure was developed, and the actuators were evaluated before implementing them in oil-injected screw compressors and screw blowers. The results demonstrated that the developed actuators could effectively position the rotor over 50 to 150 µm in radial and axial directions and significantly influence performance. The actuators reduced leakage by decreasing the head, sealline, and tip clearances and were tested across different operational ranges. Especially at low rotational speeds, leakage was strongly reduced, resulting in almost equal performance independent of rotational speed for the oil-injected screw compressor.

The study successfully validated the use of ACC in screw compressors, proving its capability to enhance performance by actively reducing the clearances. The developed actuators not only improved efficiency but also offered valuable insights into leakage paths, which will be invaluable for future screw compressor designs. Moreover, these insights can be used to improve leakage models and passive clearance control methods. These advancements in ACC can be extended to other fluid machinery, such as gas turbines and pumps, potentially leading to significant improvements in their performance and operational efficiency.