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# Challenges in the Development of Micro Gas Turbines for Concentrated Solar Power Systems

Prof. Abdulnaser Sayma

Dr. Jafar Alzaili

Department of Mechanical engineering and Aeronautics

# Outline

- Concentrated Solar Power (CSP)
- Micro Gas Turbines (MGTs) and their Application in CSP (Pure Solar Systems)
- The Technical challenges with MGTs in CSP systems
- Control Strategies for CSP Based MGTs
- Alternative MGT-CSP Systems
- Conclusion

# Concentrated Solar Power (CSP)

Main components are:

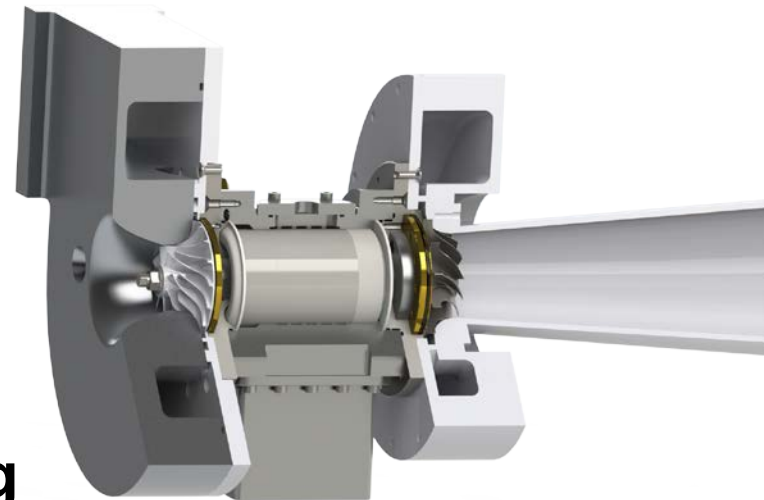
- the **Concentrator** (dish)



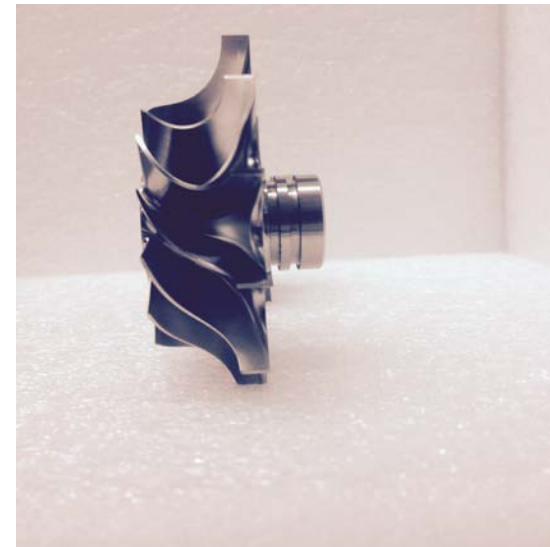
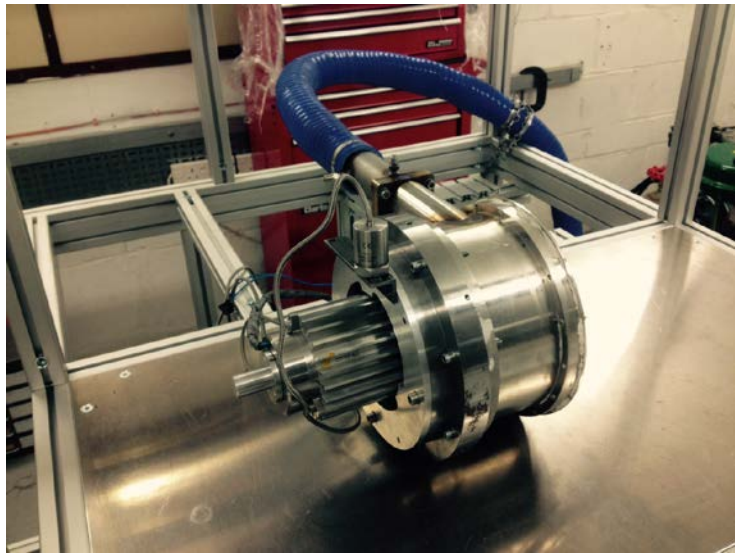
- **Solar Receiver**

# Micro Gas Turbines (MGTs)

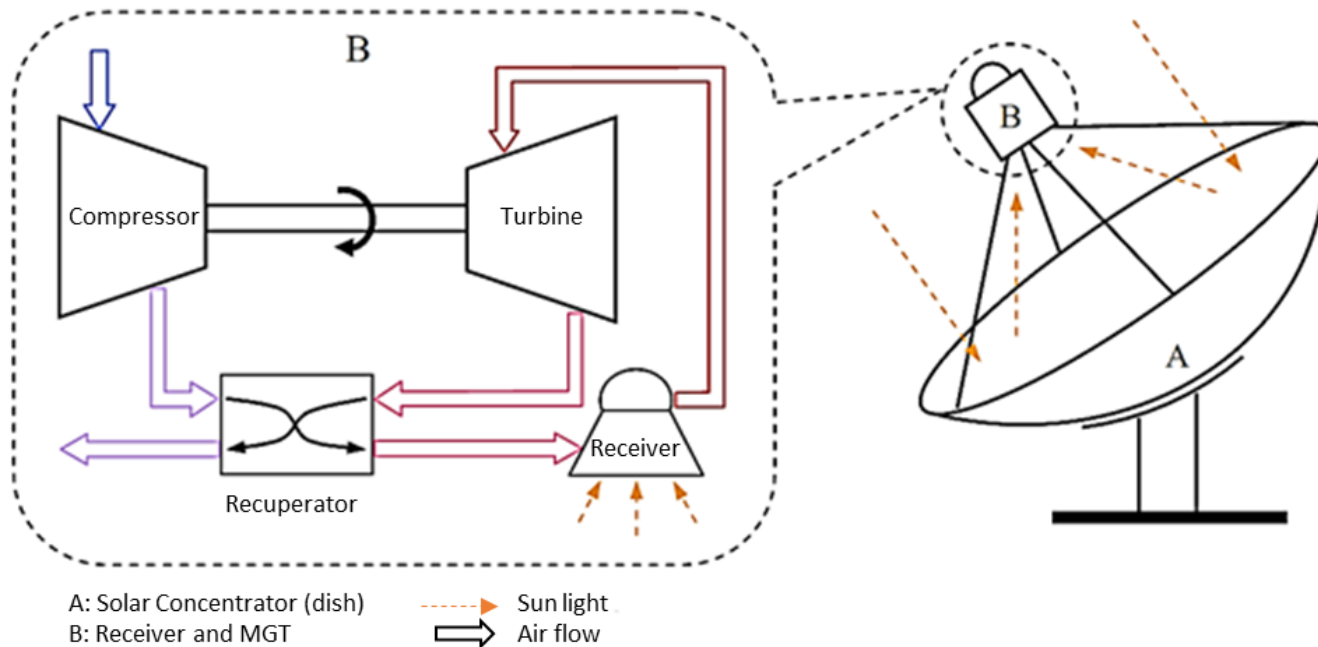
- Power range below 250 kW?
- Different applications:
  - Turbochargers
  - Distributed Power
  - Range extenders
  - UAV
  - **Renewable Energy Harvesting**



# Micro Gas Turbines (MGTs)



# CSP-based Micro Gas Turbines

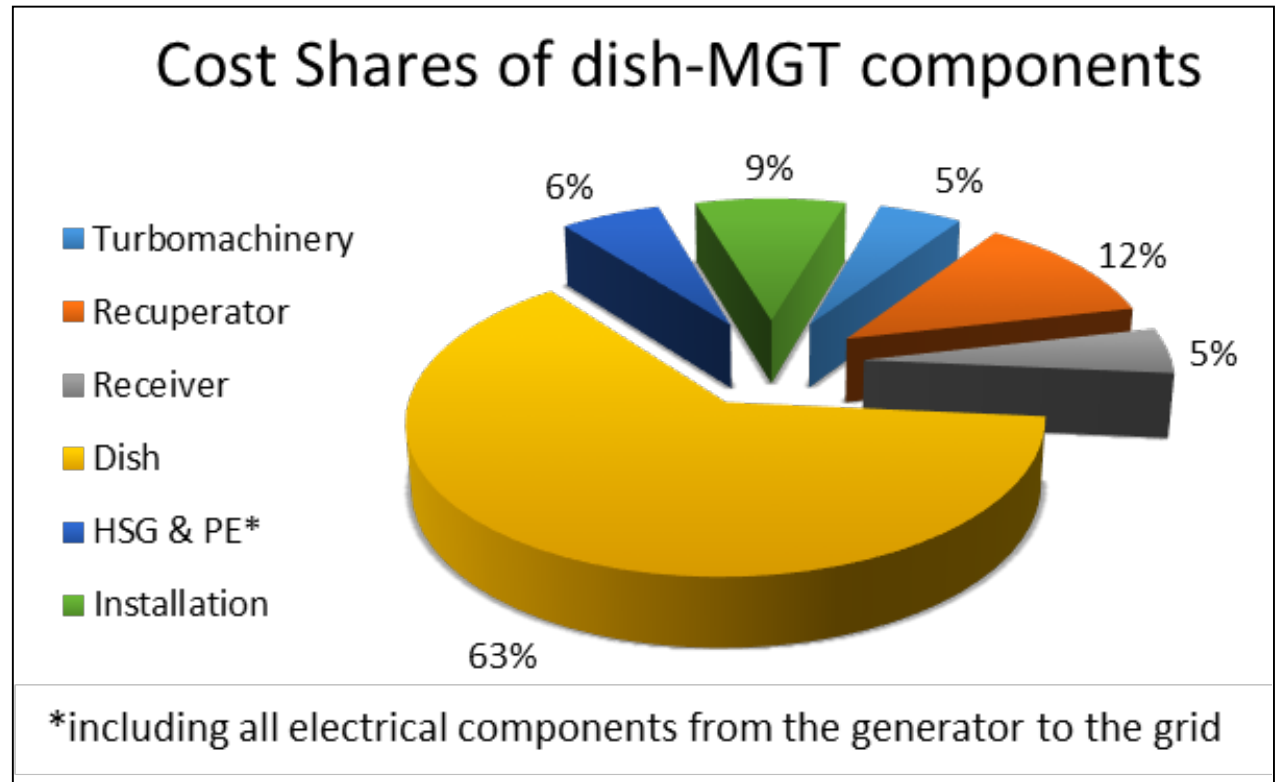


# **The Technical challenges with MGTs in CSP systems**

- Cost Considerations
- Rotordynamics and Dynamic Stability
- MGT Turbomachinery Design For Solar Application

# Cost Consideration

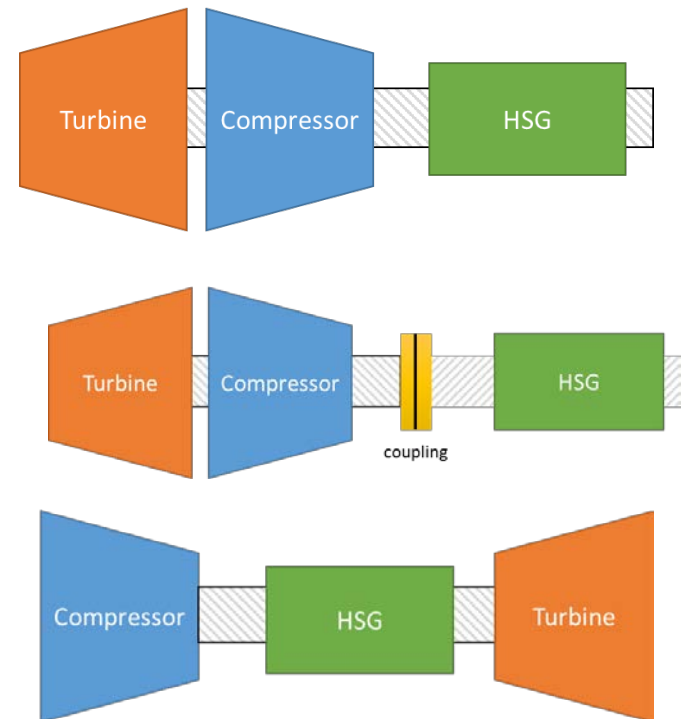
- the biggest share is the **dish**





# Rotordynamics and Dynamic Stability

- Wide range of operation in term of speed
- How to avoid the critical speeds
- Different shaft assembly  
(each has advantage and disadvantages)



# MGT Turbomachinery Design For Solar Application

- The main technical challenges would be design and manufacturing of high-efficiency turbomachinery components that are able to perform in near peak efficiency for a quite wide range of operation.

# Control Strategies for CSP Based MGTs

- Main challenge is that there we don't have control over the solar irradiation!
- **Power Electronics** is the main mean of the control available; The control system needs proper integration with the power electronic system, as practically power electronics would be the only way of controlling the micro gas turbine in absence of conventional fuels.
- PEs for high frequencies in the range of power is still **immature**

# Alternative MGT-CSP Systems

- CSP-MGT with Thermal Storage (24/7)
  - still is in the research level; high temperature is required for efficient MGT
- Hybrid Systems (with conventional or biofuels)
  - the main technical issue is the stability of the combustor in wide range of A/F ratios

# Conclusion

- The advantages of MGTs as prime mover in the CSP system
- The main technical challenges are related to design and manufacturing of high-efficiency turbomachinery components
- The control system needs proper integration with the power electronic system
- For continues power generation the thermal storage should be coupled with the MGT in excess of 800°
- A preliminary study showed that generator-in-middle arrangement has more potential to operate in wider range of speed, which is the case for the solar application.

City, University of London  
Northampton Square  
London  
EC1V 0HB  
United Kingdom

T: +44 (0)20 7040 5060  
E: [a.sayma@city.ac.uk](mailto:a.sayma@city.ac.uk)  
[www.city.ac.uk](http://www.city.ac.uk)

**Thank you**

An aerial photograph of London, England, with a semi-transparent red overlay. The image shows a dense urban landscape with various buildings, streets, and green spaces. The London Eye is visible on the left side of the image. The overall tone is a deep red, which serves as a background for the white text.