Performance Assessment of Hydrogen Fueled Gas Turbines

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Background and motivation

- Energy sector is responsible for ~73% GHG emissions globally
- EU countries pledged to decrease a 55% of GHGs by 2030
- EUTurbines committed to influence net zero carbon emissions by 2030
- Gas turbines industry prioritize H2 fuel among the other low carbon fuels
- H2 has drastically different thermophysical properties as compared to natural gas
- H2 combustion flue gasses have enhanced steam content

Primary objective

- To identify most vulnerable degradation mechanisms by doing fault diagnosis in H2 fuel scenario

Secondary objectives

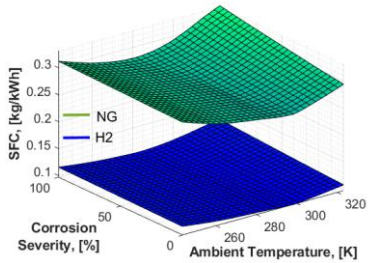
- To develop a validated design point and off design model (e.g. part load) using manufacturer's and experimental data, respectively
- To simulate various fault scenarios i.e., fouling, erosion and corrosion
- To investigate the effect of switching NG to H2, on remaining useful life (RUL) of MGT

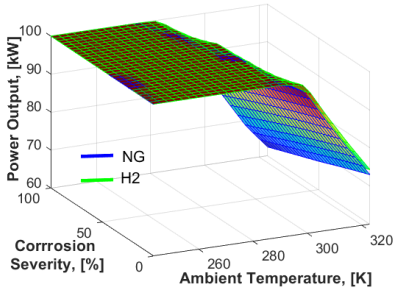
Recent Progress

- Developed design point and off design performance model of 100 kW MGT using GasTurb14 tool
- Validated the model with the baseline data with NG
- Investigated the combined effect of H2-induced corrosion and ambient temperature variations on the performance of the MGT
- Evaluated the effect of corrosion degradation for both natural gas and H2

Preliminary Findings

Flue gas compositions from combustion			
Methane Reaction		Hydrogen Reaction	
Component	Mass fractions	Component	Mass fractions
CO_2	0.1514	CO_2	-
H_2O	0.1239	H_2O	0.2548
N_2	0.7246	N_2	0.7453





Muhammad Baqir Hashmi is currently working as a PhD Research Fellow at Department of Energy and Petroleum Engineering, University of Stavanger, Norway. His research focuses numerical and experimental performance assessment of hydrogen fueled gas turbines. He completed a Masters degree in Mechanical Engineering from Universiti Teknologi PETRONAS (UTP), Malaysia. During his masters, he was involved in an industry funded project "Transient modeling and intelligent fault diagnosis of variable geometry industrial gas turbines".

Estimated progress of the PhD project:

Just started ...	< 50 %	> 50 %	Almost done ☺

Publications

- "Effect of hot gas path component corrosion on the performance of hydrogen fueled micro gas turbines", Muhammad Baqir Hashmi, Mohammad Mansouri, Peter Brehaus, Tamiru Alemu Lemma, ASME Turbo Expo 2023, Boston, Massachusetts [Under Revision]
- "Dynamic Performance and Control Strategies of Micro Gas Turbines: State-of-the-Art Review, Methods and Technologies", Muhammad Baqir Hashmi, Mohammad Mansouri, Mohsen Assadi, Energy Conversion and Management X, Elsevier [Under Revisions]

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