



Combustor Sector Performance

with Synthetic-Paraffinic-Kerosene
Fischer-Tropsch Fuel

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NASA Aeronautics Scholarship Program

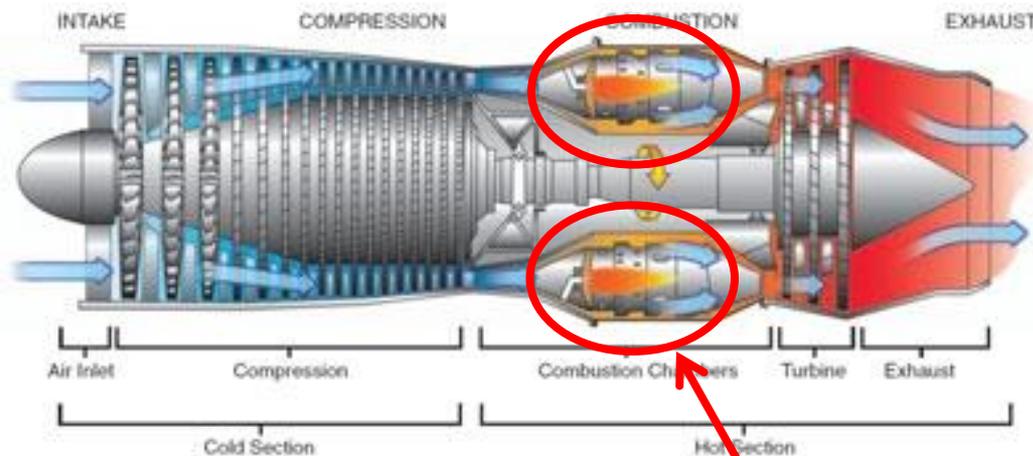
Georgia Institute of Technology, Senior

Mentor: Robert C. Hendricks, R000

NASA Glenn Research Center

Objective

- General:
 - Reduce Fuel Burn
 - Reduce Emissions
 - Increase Engine Performance



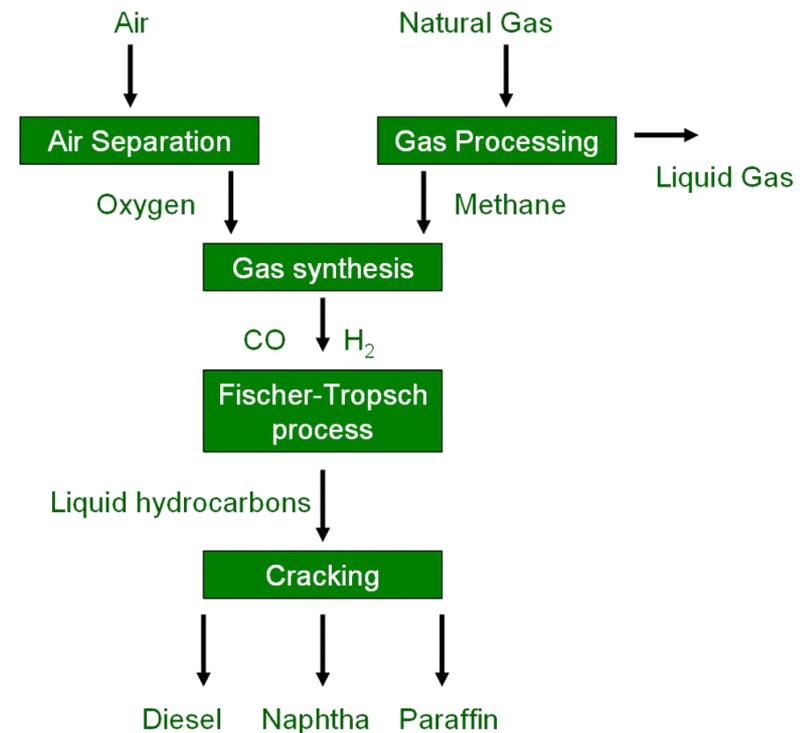
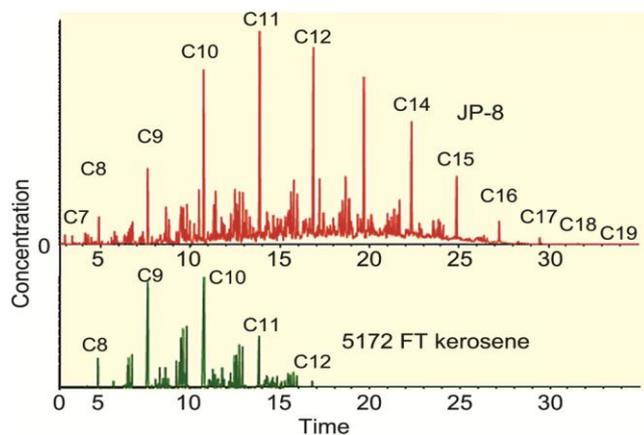
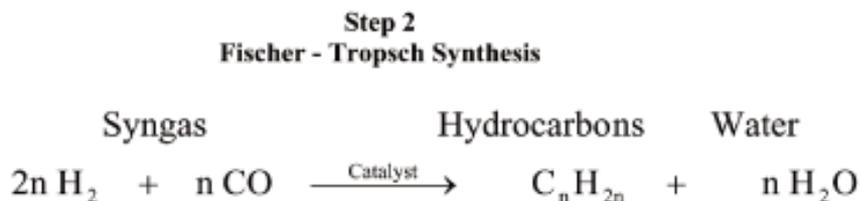
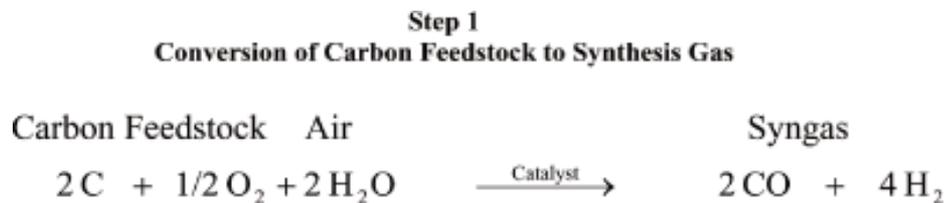
Gas Turbine Jet Engine- Combustor

- Specific:
 - Synthetic-Paraffinic-Kerosene (SPK) Fischer-Tropsch (FT) Fuel effect on combustor performance with JP-8 petroleum jet fuel as baseline



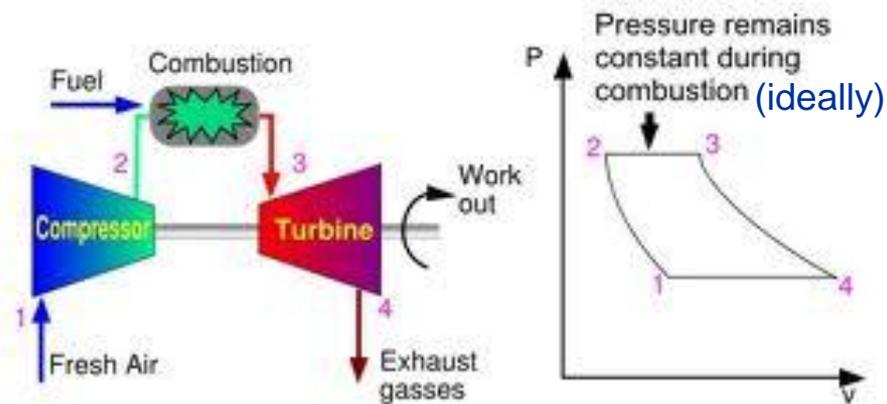
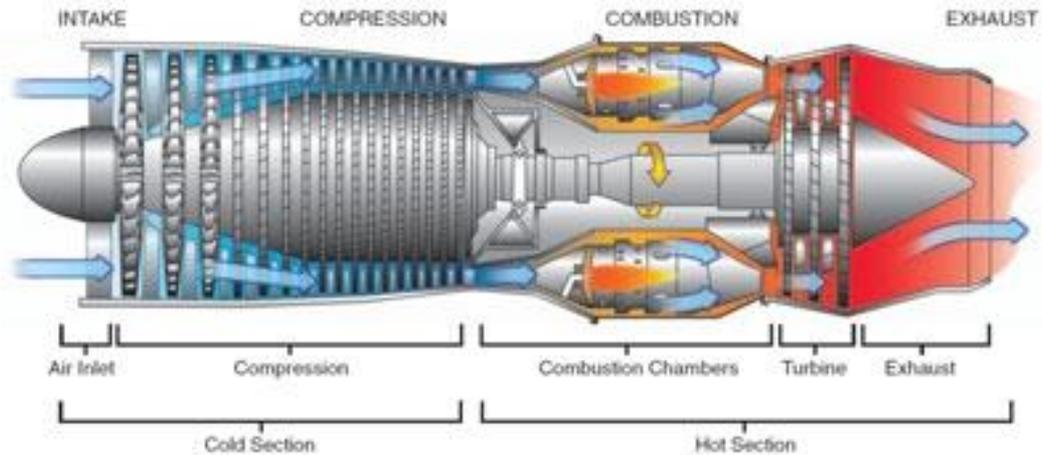
Background

- Fischer-Tropsch (FT) Fuel:



Background

- Gas Turbine Engines





Experiment

- Testing Variables:
 - FT fuel in 0%, 50%, and 100% blends with JP-8
 - Four inlet pressures and temperatures:
 - 75 psia (0.517MPa) and 500°F (533K)
 - 125 psia (0.862MPa) and 625°F (603K)
 - 175 psia (1.207MPa) and 725°F (658K)
 - 225 psia (1.551MPa) and 790°F (694 K)
 - Combustor pressure drop ($\% \Delta P$): 3%, 4%, and 5%
 - Fuel-to-air ratios (F/A): 0.010, 0.015, 0.020, 0.025

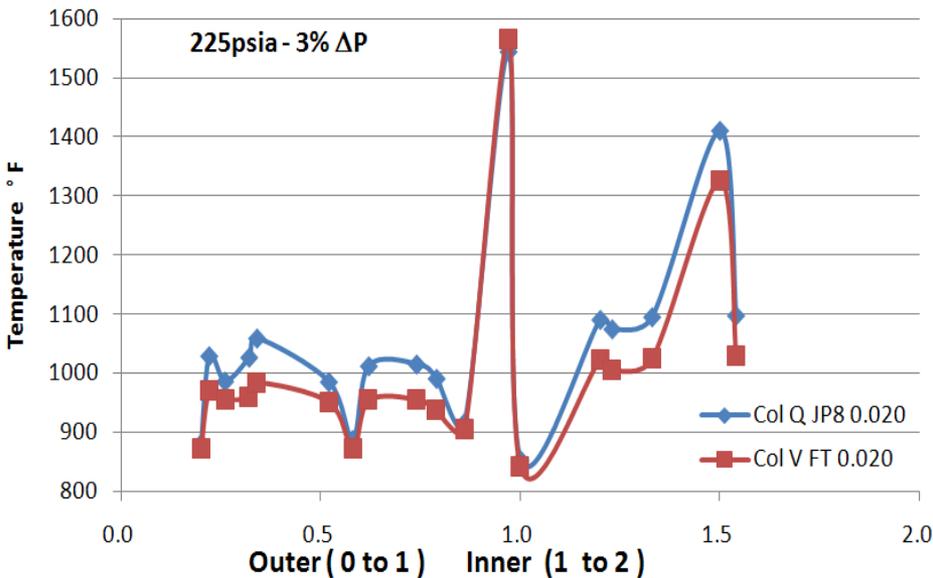




Results

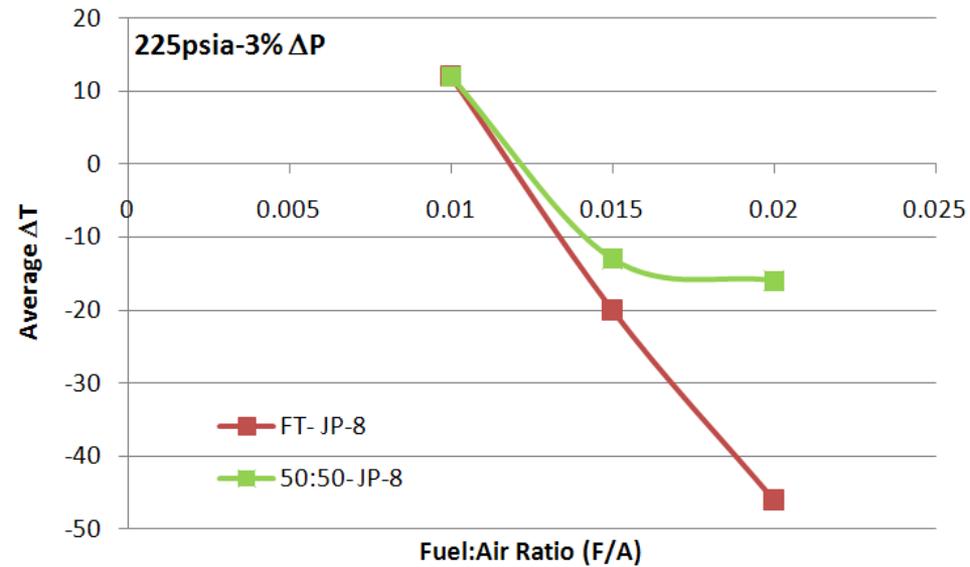
Unwrapped liner temperatures

225psia (1.55MPa) at 3% ΔP



Average liner temperature differences

225psia (1.55MPa) at 3% ΔP

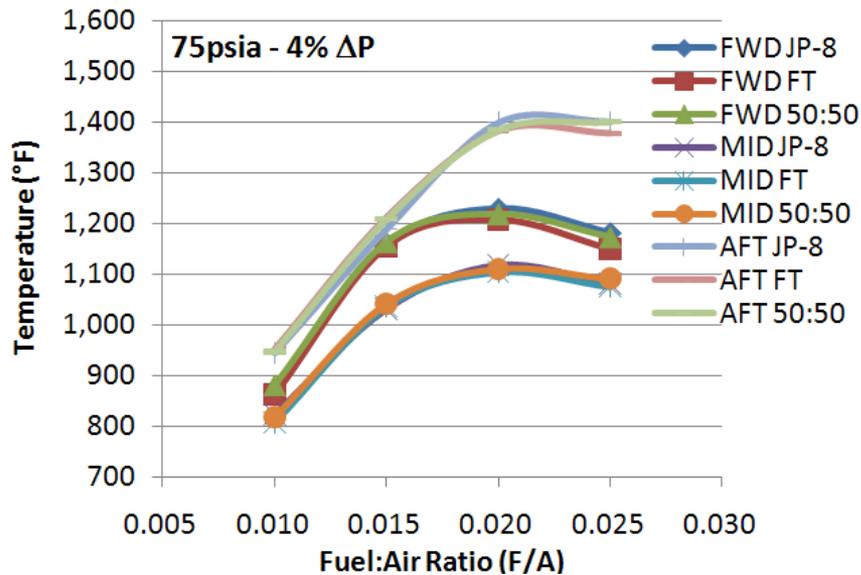




Results

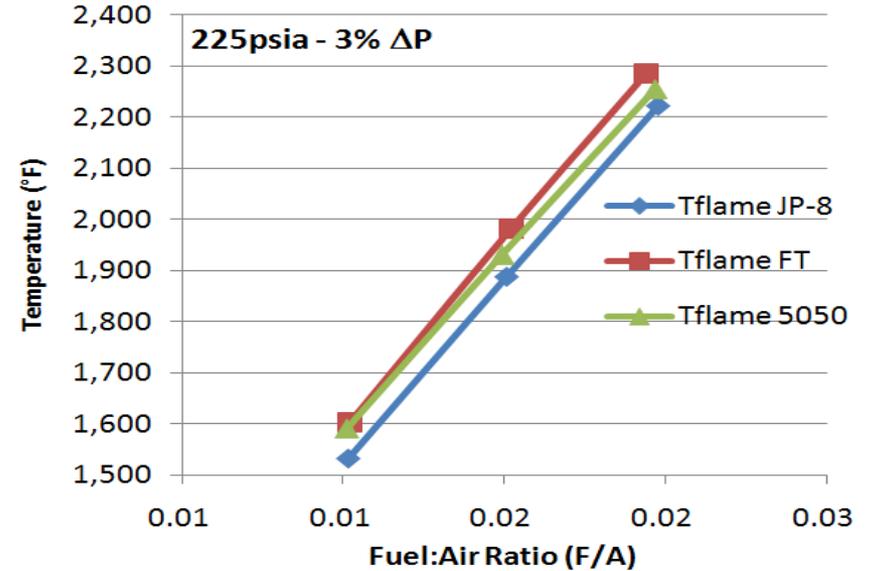
Combustor Sidewall Temperature

75psia (0.52MPa) at 4% combustor ΔP



Calculated Exhaust temperatures

225psia (1.55MPa) at 3% combustor ΔP





Conclusions

- **Sidewall Temperatures:**
 - Strong dependence on F/A ratio, but not on fuel composition
 - Decrease with increasing % combustor ΔP
- **Liner Temperatures:**
 - F/A = 0.010: JP-8 cooler than 50:50 blend or 100% FT
 - F/A \geq 0.015: 100% FT and 50:50 blend cooler than JP-8
- **Calculated and Experimental Exhaust Temperatures:**
 - FT > 50:50 blend > JP-8 temperatures
 - Independent of % combustor ΔP



Future Research

- Testing biofuels and other fuels
 - Combustor performance
 - Overall engine performance
 - Emissions analysis
- New aircraft designs





Acknowledgements

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Thank You

Questions?

