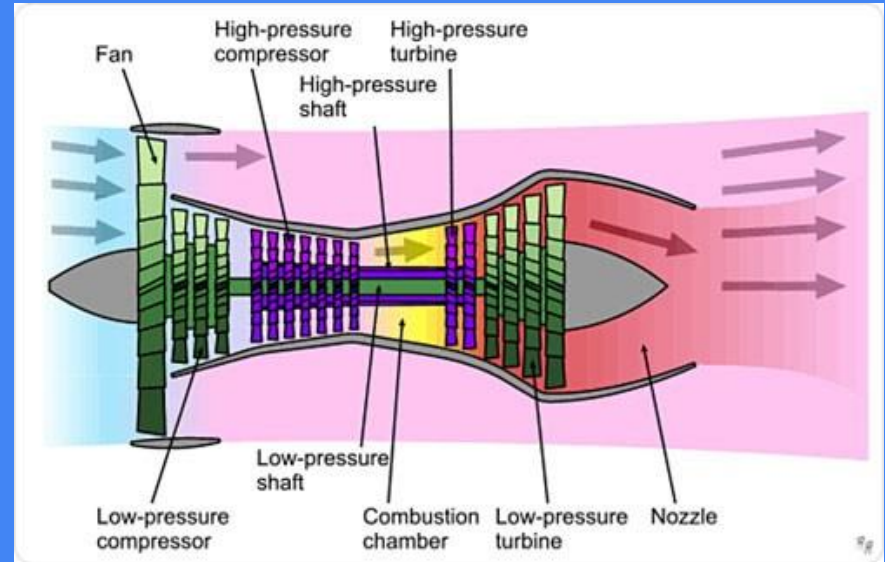


Thermodynamic Demo

Unit 1B

Erich Gemballa - Sensor & Data Lead
Gavin Geiger - Compressor Lead
Brendan Savelli - Combustion Lead
Hamad Almutairi - Casing &
Materials Lead
Abdullah Abdulghafour - Turbine
Lead



Project Description

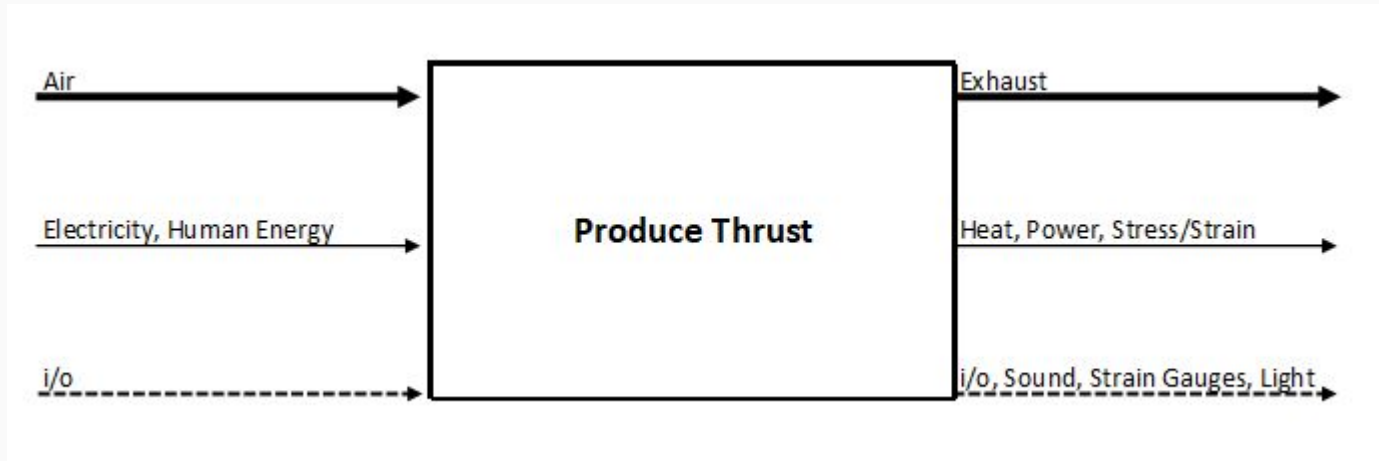
To design a brayton cycle consisting of a high bypass turbofan for thermodynamics educational uses

Client: David Willy

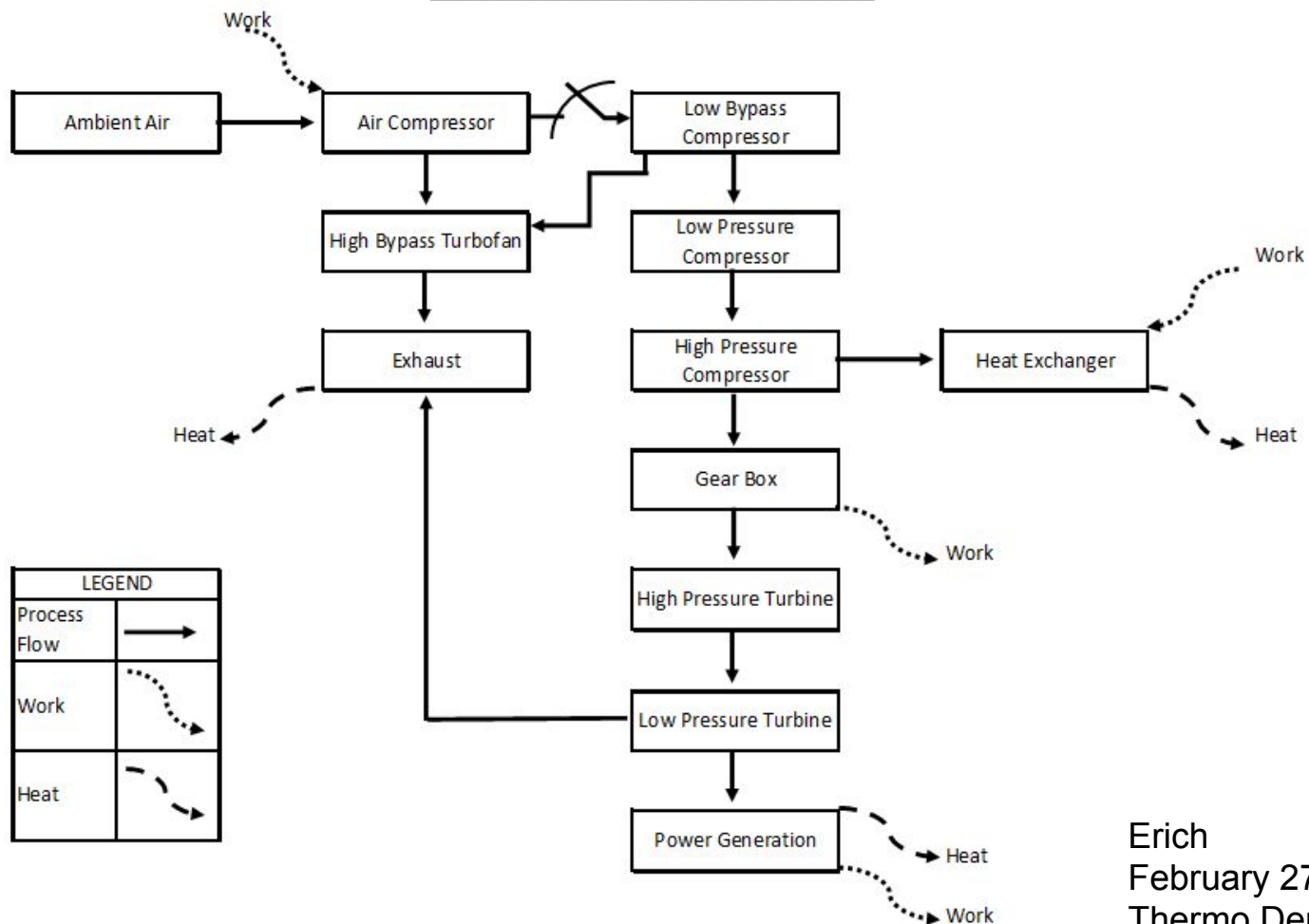
The team plans to design and construct a working 8:1 Bypass Ratio for the Brayton Cycle

Project Decomposition

Black Box Model



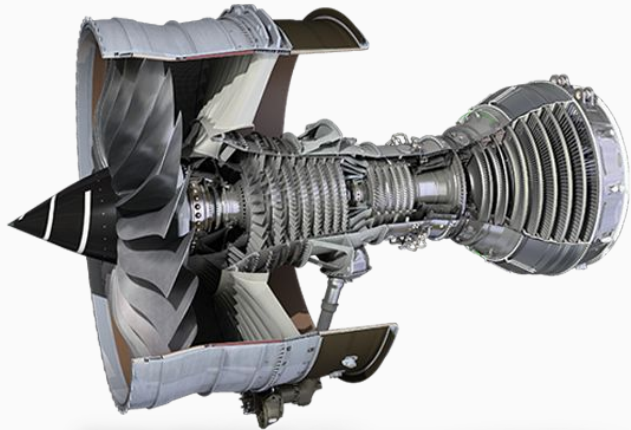
High Bypass Turbofan Decomposition



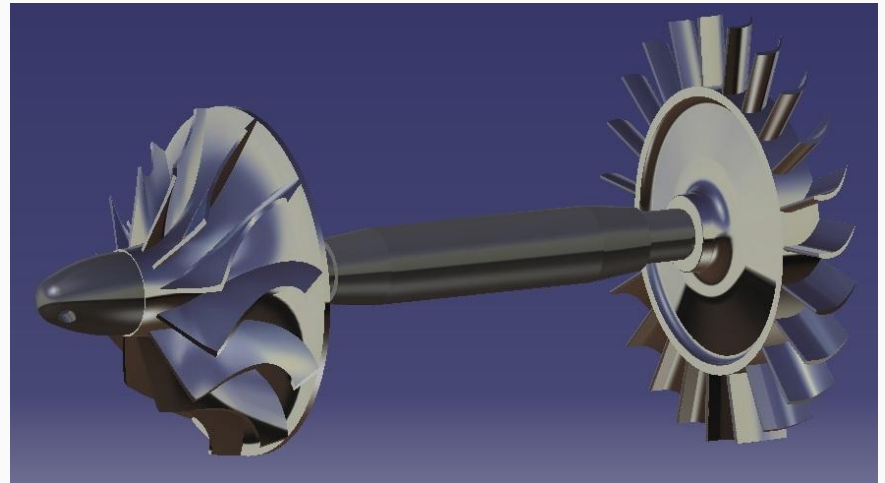
Erich
February 27, 2018
Thermo Demo Unit: 1B

Researched Designs

Current Rolls Royce Trent Engine



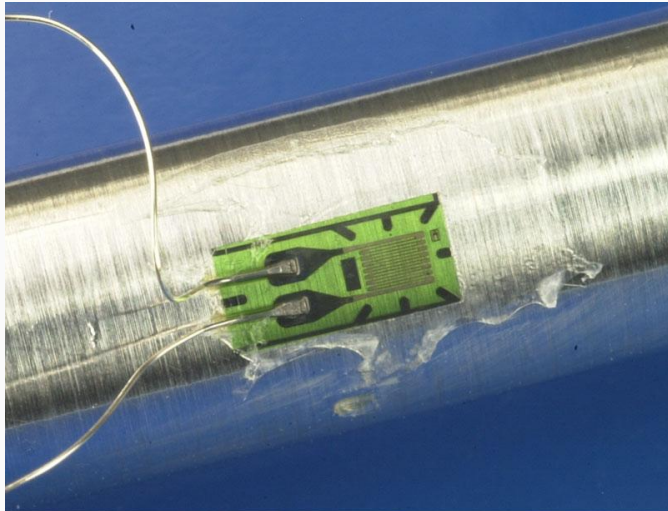
Double Shaft



Gavin
February 27, 2018
Thermo Demo Unit: 1B

Data Acquisition

Strain Sensors



Pitot Static Tube



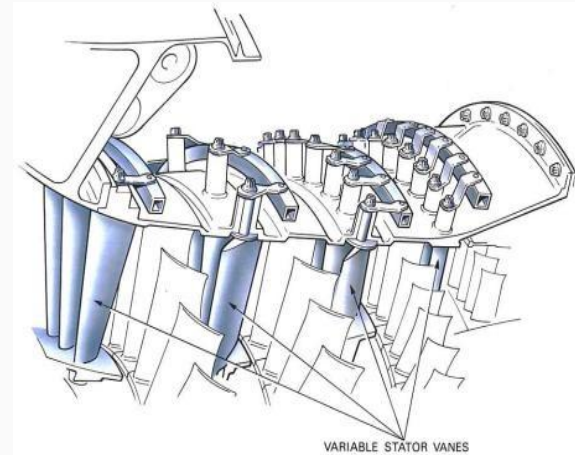
Stator Blades

Located on Inner Casing

- Easier to construct and implement

Located on Shaft

- Complicates design with rotational shaft



Gear Box

No Gearbox

Loss of work from driving shaft

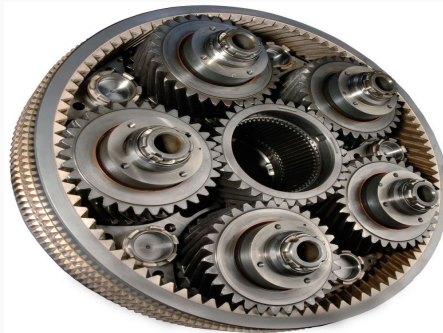
Cheaper and less work required to implement

Demonstrates the power output from aerodynamic thrust

Gearbox

Added Aerodynamic drag

Control of Gear ratios to display Turbofan gearboxes

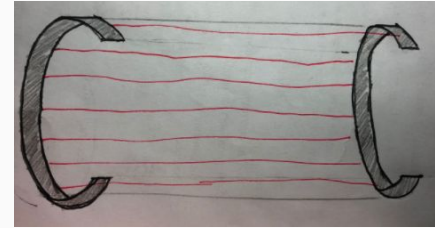
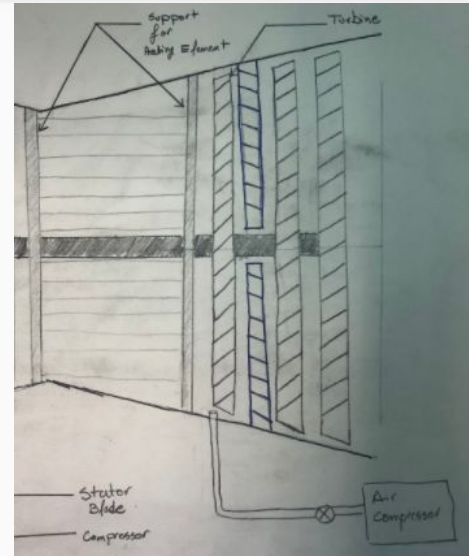


Hamad
February 27, 2018
Thermo Demo Unit: 1B

Combustion Chamber

- Heat will be added with a heating element run longitudinally through the combustion chamber
- **Issue:** 3D printer filament has a glass transition temperature of $105\text{ }^{\circ}\text{C}$

Solution: Compressed air will be used simulated the isobaric expansion usually accomplished by combustion



Brendan
February 27, 2018
Thermo Demo Unit: 1B

Decision Matrix

		Stator Blade on casing	Stator Blade on shaft	Gear box	No Gear box
		Concept 1	Concept 2	Concept 5	Concept 6
Criteria	Weight				
Work Output	5	S	S	+	-
Isentropic Efficiency	3	+	-	+	-
Thermal Capacity	2	S	S	S	S
Volume	3	S	S	+	-
Data acquisition	5	S	S	S	S
Cost	3	S	S	+	-
Aerodynamic	4	S	S	-	+
Internal Velocity	3	S	S	-	+

Brendan
February 27, 2018
Thermo Demo Unit: 1B

Proposed Design

Pitot Static Tubes

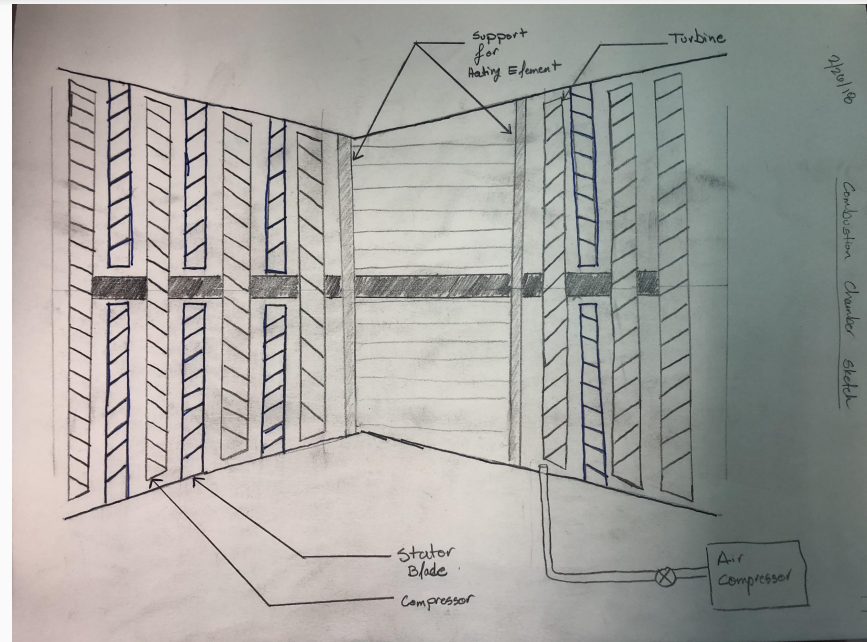
Thermocouple

4:3 Compressor to Turbine Ratio

Hot Wire Cutter for heating element

8:1 Bypass Ratio

No Gear box



GANTT

		2/6 - 2/8	2/13 - 2/15	2/20 - 2/22	2/27 - 3/1
		Week 4	Week 5	Week 6	Week 7
Task	Assigned				
Team Charter	All				
Peer Eval 1	All				
Presentation 1	All	Presentation 1			
Website	Brendan				Website
Conceptual Report	All		Conceptual Report		
Presentation 2	All				Presentation 2
Analyses Memo	All				
Website 2	Brendan				

Abdullah
February 27, 2018
Thermo Demo Unit: 1B

Schedule

Milestones:

3D Benchmark Prototype: March 16

Compressor Blade Design: May 4

Turbine Blade Design: May 4

Heating Element Designed and Built: March 16

Hamad
February 27, 2018
Thermo Demo Unit: 1B

Budget

Gavin
February 27, 2018
Thermo Demo Unit: 1B

Material	Cost per Unit	Estimated Amount	Total \$
Strain Gauge	\$175	1	\$ 175.00
Colored 3D Printer Filament	\$25	10	\$ 250.00
Clear 3D Printer Filament	\$20	2	\$ 40.00
LED Lightbulb	\$7.50	1	\$ 7.50
Wiring	\$1	1	\$ 1.00
Air Compressor w/ 2 Gal Tank	\$75	1	\$ 75.00
Pressure Regulator	\$15	1	\$ 15.00
Brushless DC Generator	\$15	1	\$ 15.00
Heating Element	\$30	1	\$ 30.00
Tubing and Connections	\$20	1	\$ 20.00
1/2" Aluminum Shafts	\$10	1	\$ 10.00
Gearing for Gear Box	\$50	1	\$ 50.00
Thermal Couplers	\$4	5	\$ 20.00
Pressure Gauges	\$7.50	2	\$ 15.00
Material for Pitot Tube	\$10	4	\$ 40.00
Miscellaneous Expenses	\$50	1	\$ 50.00
Estimated Total:			\$ 813.50

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