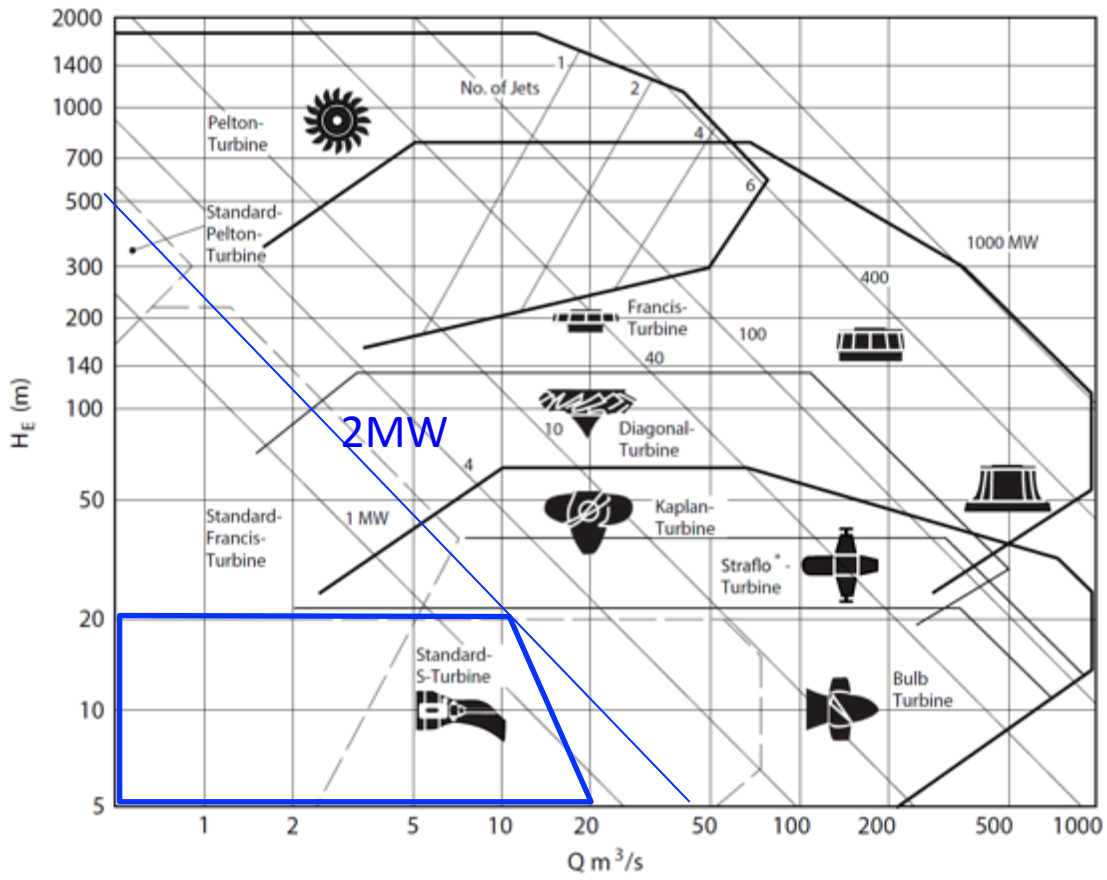
Metodi Zlatinov

Senior Mechanical Engineer

Natel Energy

02/2017 – present
Senior Mech. Engineer, Natel Energy

Natel's Design Space



Natel Design Space

Irrigation Canal

Non-Powered Dam

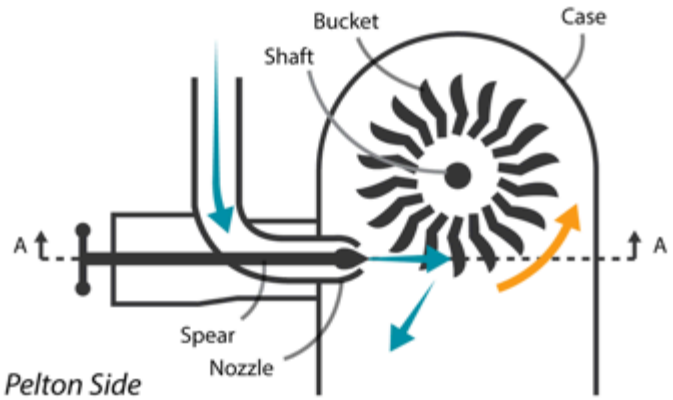
New Stream Reach

Unlocking the potential of low head hydro

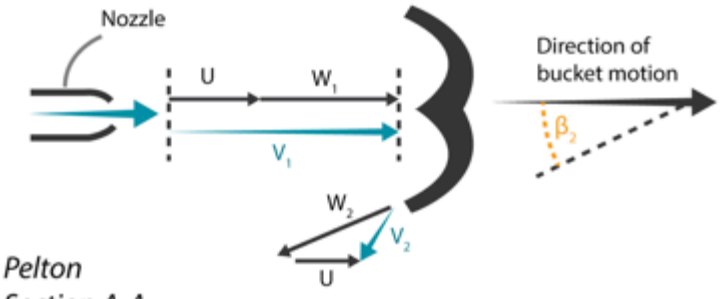
Power Density Problem: Low Head / High Flow → Big equipment, high cost

Natel's Turbine

Conventional Pelton

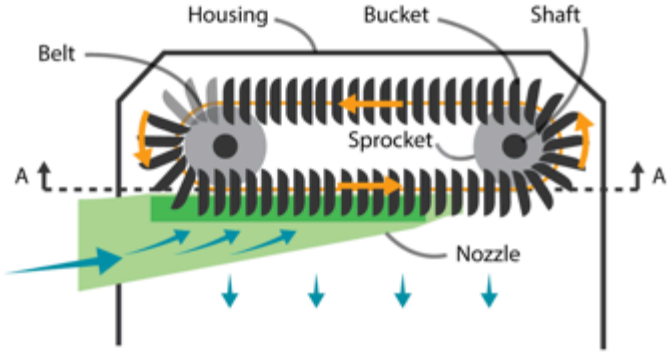


Pelton Side View

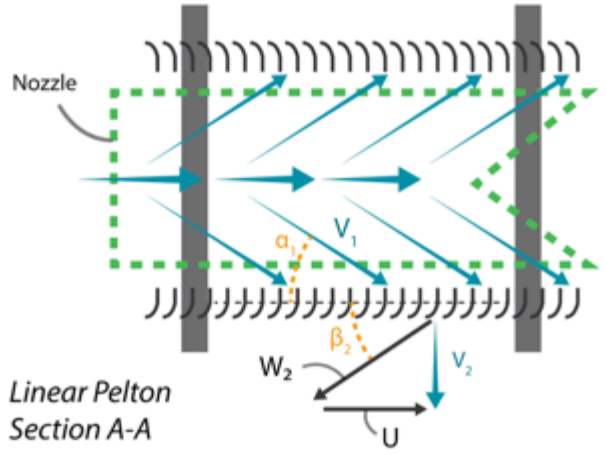


Pelton Section A-A

Natel's Linear Pelton (LP)



Linear Pelton Side View



Linear Pelton Section A-A

Personal Contributions

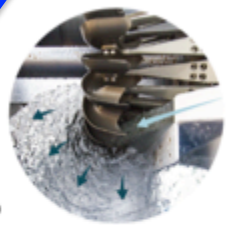
- Developed database of technical requirements
- Managed technical spec for the product line
- Led successful bid for $1.9M DOE grant

- Fluid and mechanical design of fish fish-friendly turbine bucket; collaborated on DFM.

- Fluid design of nozzle; collaborated on mechanical and DFM
- Fluid and mechanical design of slide gate
- Improved part-flow efficiency by 4 %-pt

Nozzle

Water entering into the machine passes through the penstock and then a nozzle. The nozzle distributes the water along a linear array of buckets.



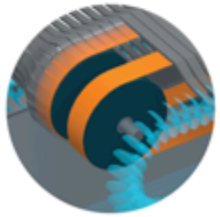
Flow

After the high velocity water exits the nozzle, its momentum is captured by the buckets. Water exits with just enough velocity to cleanly exit the buckets. The buckets are designed with rounded edges to be fish friendly.

- Sized components for hydraulic testing facility
- Conducted hydraulic testing to identify and address efficiency problems

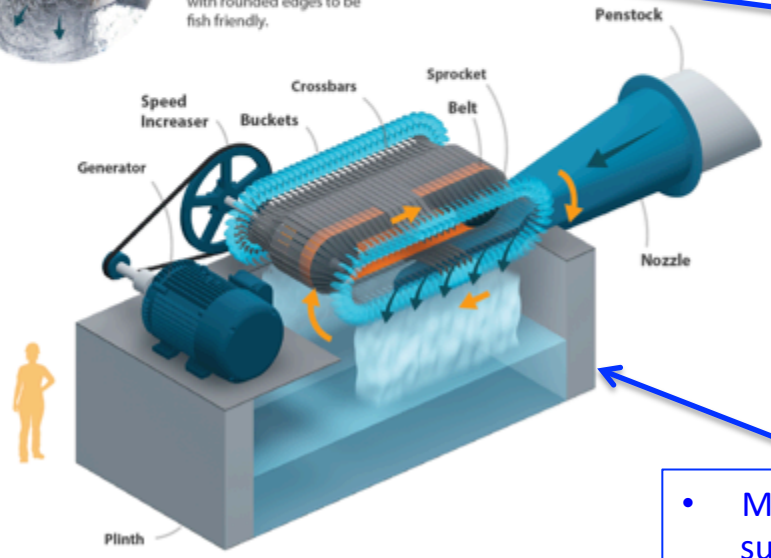
Buckets / Crossbars

After the water's momentum has been transferred to the buckets, force is delivered to the belt through a metal part called the crossbar. The buckets and crossbars are carefully designed to minimize rolling and pitching moments. This dramatically simplifies the crossbar to belt attachment.



Belt / Sprocket

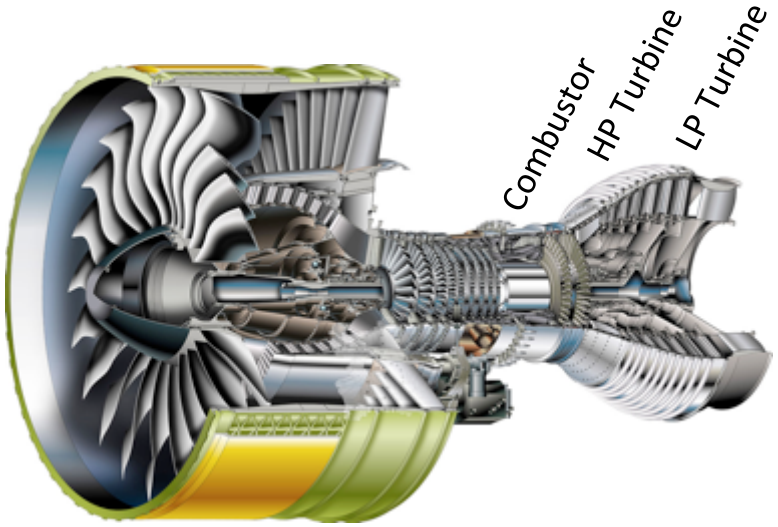
The machine's composite belts transfer force from the crossbars to the sprockets. The sprocket and the belt convert the machine's linear motion into rotary motion, which is then converted to electricity by a conventional generator.



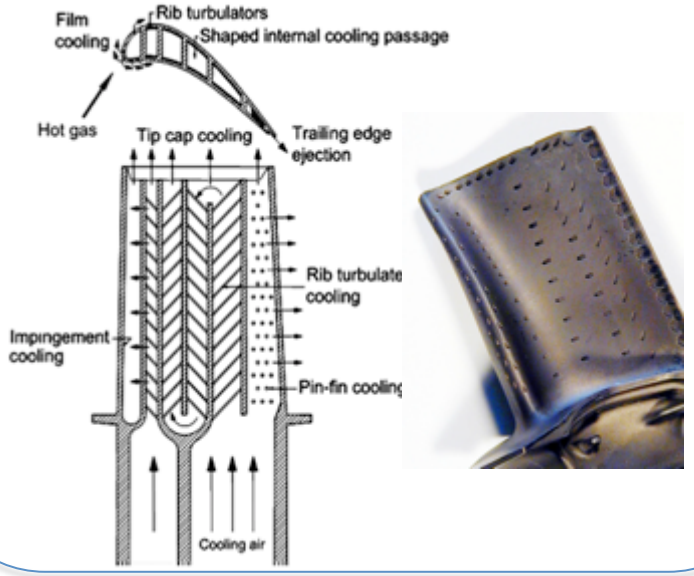
- Managed a team of subcontractors and collaborators to innovate on balance of plant

08/2013 - 02/2017
Lead Engineer, GE Aviation

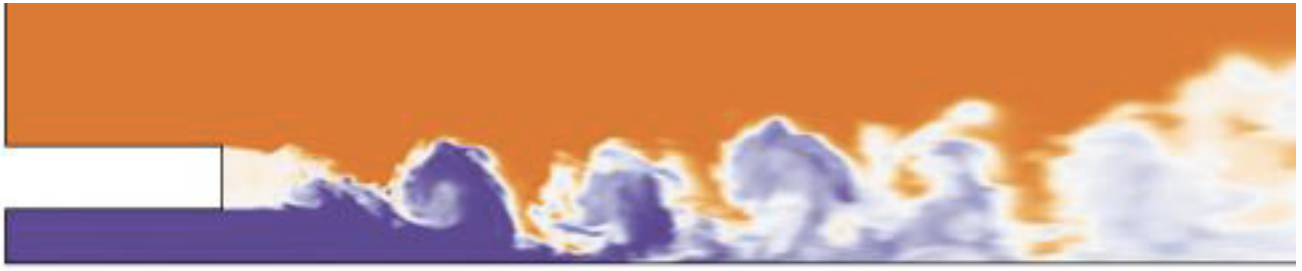
Aviation Turbofan



Cooled turbine blade



Aero-Thermal Design/Optimization with Hi-Fi CFD



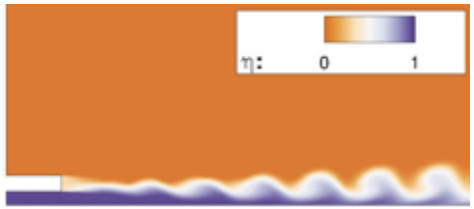
Hi-Fi CFD for Aero-Thermal Design

- Aerodynamics, Heat Transfer and Performance are interconnected
- Testing is expensive, CFD is getting more powerful
- CFD for Analysis → CFD for Design/Optimization
- Hi-Fi CFD (e.g. LES) much more computationally expensive… but necessary for some types of problems

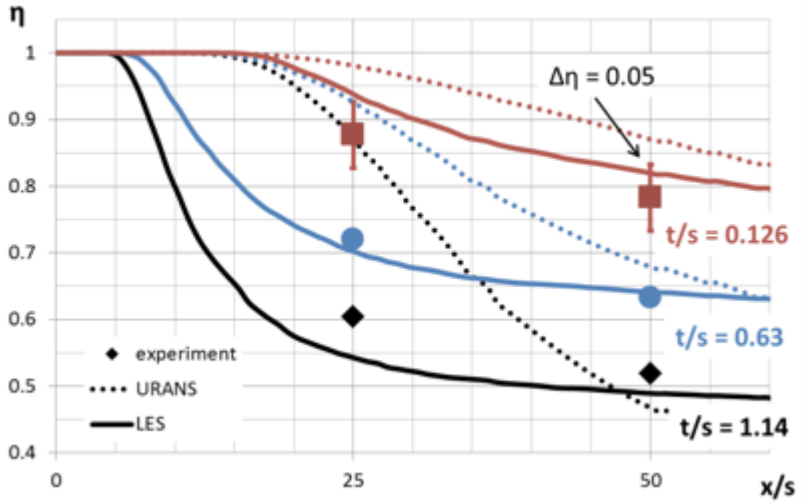
Example: Simplified TE cooling slot
RANS → URANS → DES → LES → DNS
Fewer assumptions/empirical models… but higher cost

$$\eta = \frac{T - T_H}{T - T_C}$$

URANS



LES (k-eq)

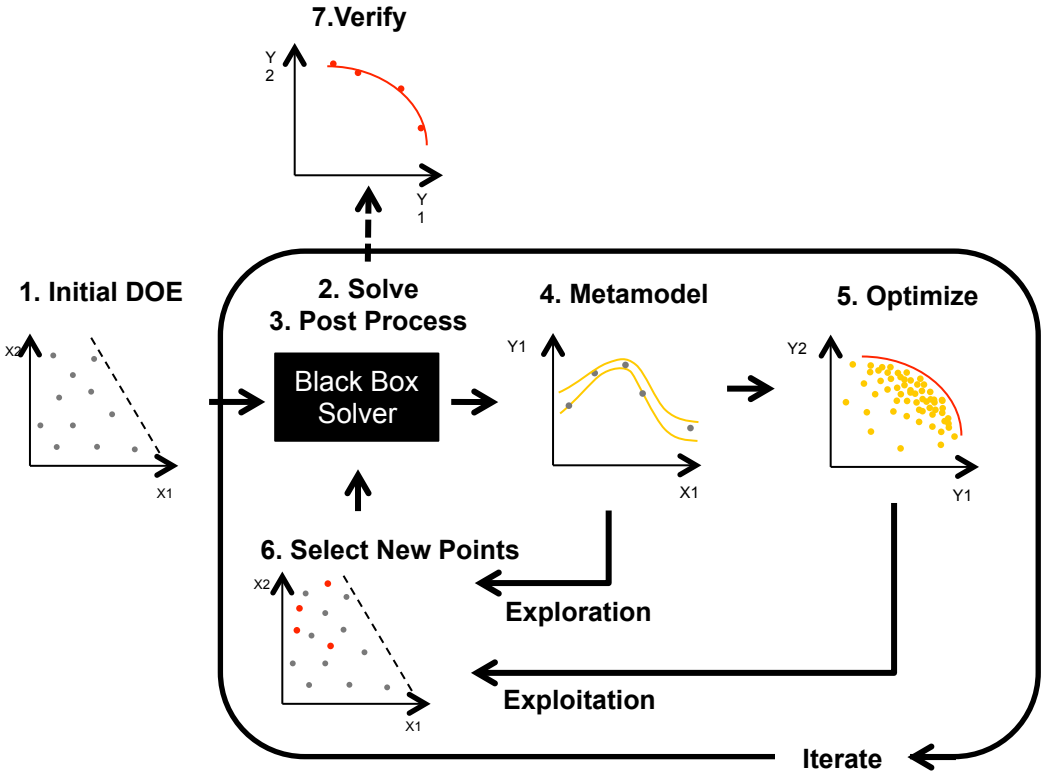


Ivanova and Laskowski, "LES and Hybrid RANS/LES of a Fundamental Trailing Edge Slot", ASME Turbo Expo 2014, Paper No. GT2014-25906

Metamodel-assisted Optimization

Developed in-house tool for CFD-based optimization:

- Interpolate between expensive black-box solver solutions (e.g. CFD)
- Intelligent and efficient iterative sampling
- Automated process (CAD, Mesh, CFD, Post process, Optimize, Iterate)



Allow “expensive” CFD to be used as a design tool

Example:
Optimization of Turbulated Cooling Passage

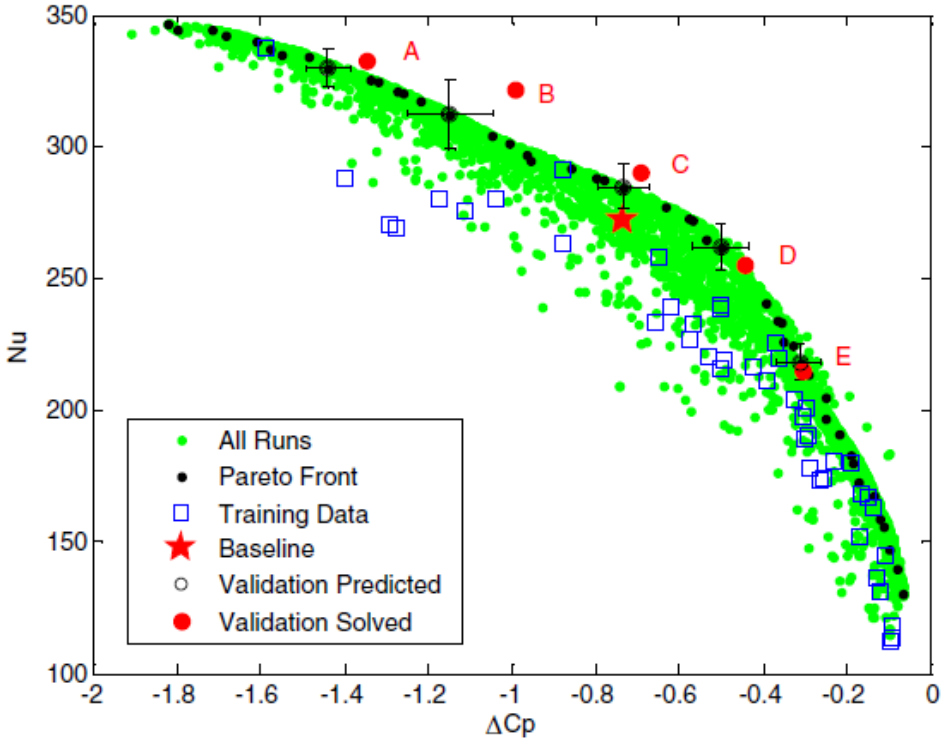


Fig. 8 Pareto front from metamodel assisted optimization, with validation points.

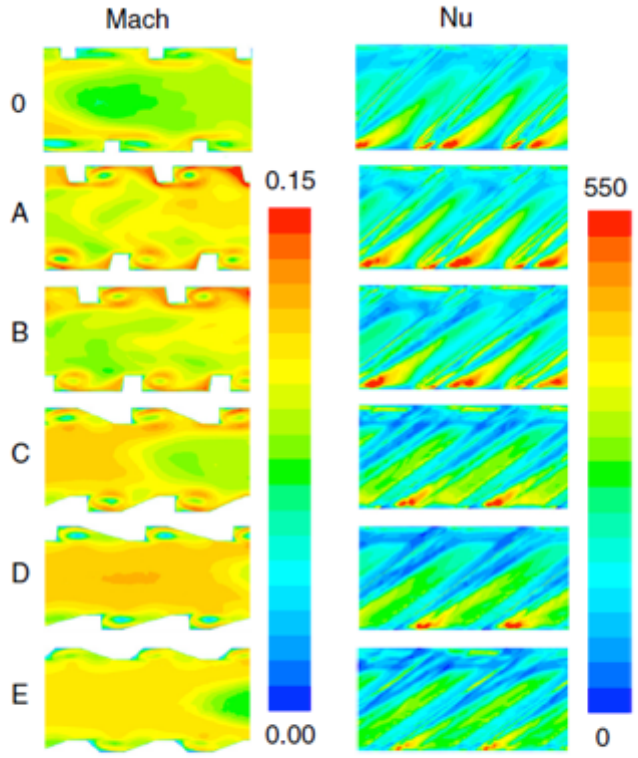
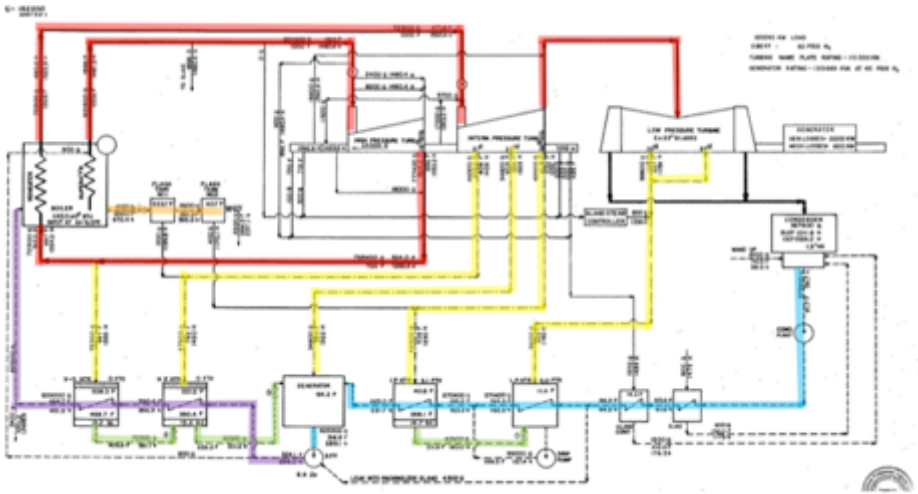


Fig. 10 Comparison of baseline case (0) and selected designs from Pareto front (see Fig. 8 for numbering). Flow direction is from left to right.

- Pareto front in Y-space shows optimal engineering tradeoffs
- Pareto front in X-space (not shown) provide insight into why

06/2011 – 07/2013
Mechanical Engineer, Altran

Structural analysis of power plant piping and pressure vessels, in accordance with the ASME codes, field inspections and failure analysis

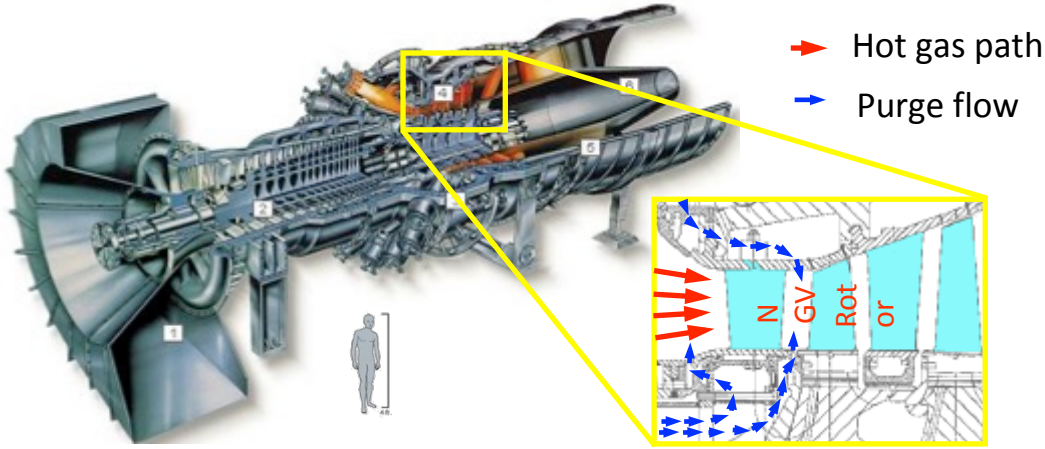


Major Systems:

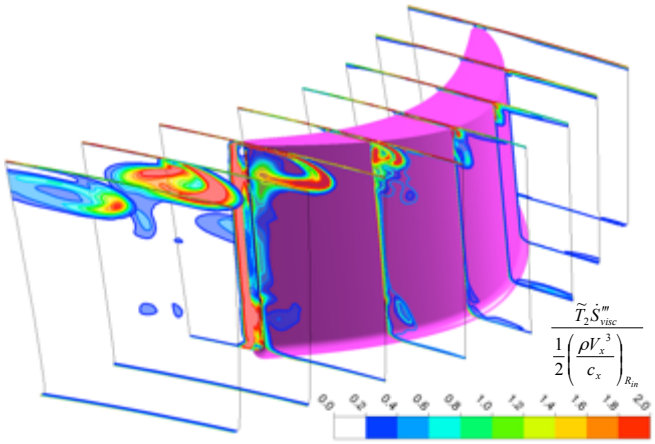
- **Condensate**
- **Feedwater**
- **Main Steam**
- **Extraction Steam**
- **Heater Drains**
- **Blowdown**

09/2009 – 06/2011
MIT Gas Turbine Lab

- CFD-based research into the loss mechanisms associated with purge flow
- 2012 paper awarded Best Paper Awarded at largest ASME conference (IGTI Turbo Expo)

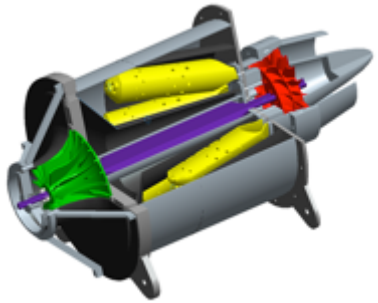


Local rate of entropy generation

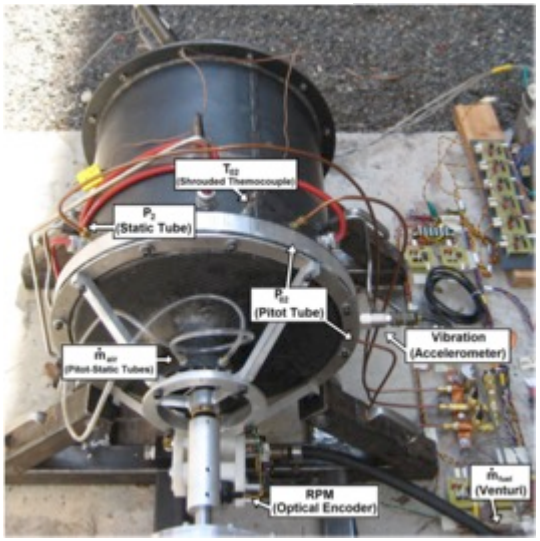


09/2005 - 06/2009
Princeton University

Senior Thesis: Collaborated on design, building and testing of 100 kW gas turbine



$$\omega = 40{,}750 RPM$$
$$\pi_c = 3.29$$
$$T_3 = 1000 K$$
$$\dot{m} = 2\, kg/s$$
$$\dot{W} = 100 kW$$



Class project: Design of an autonomous robot for shelving cans