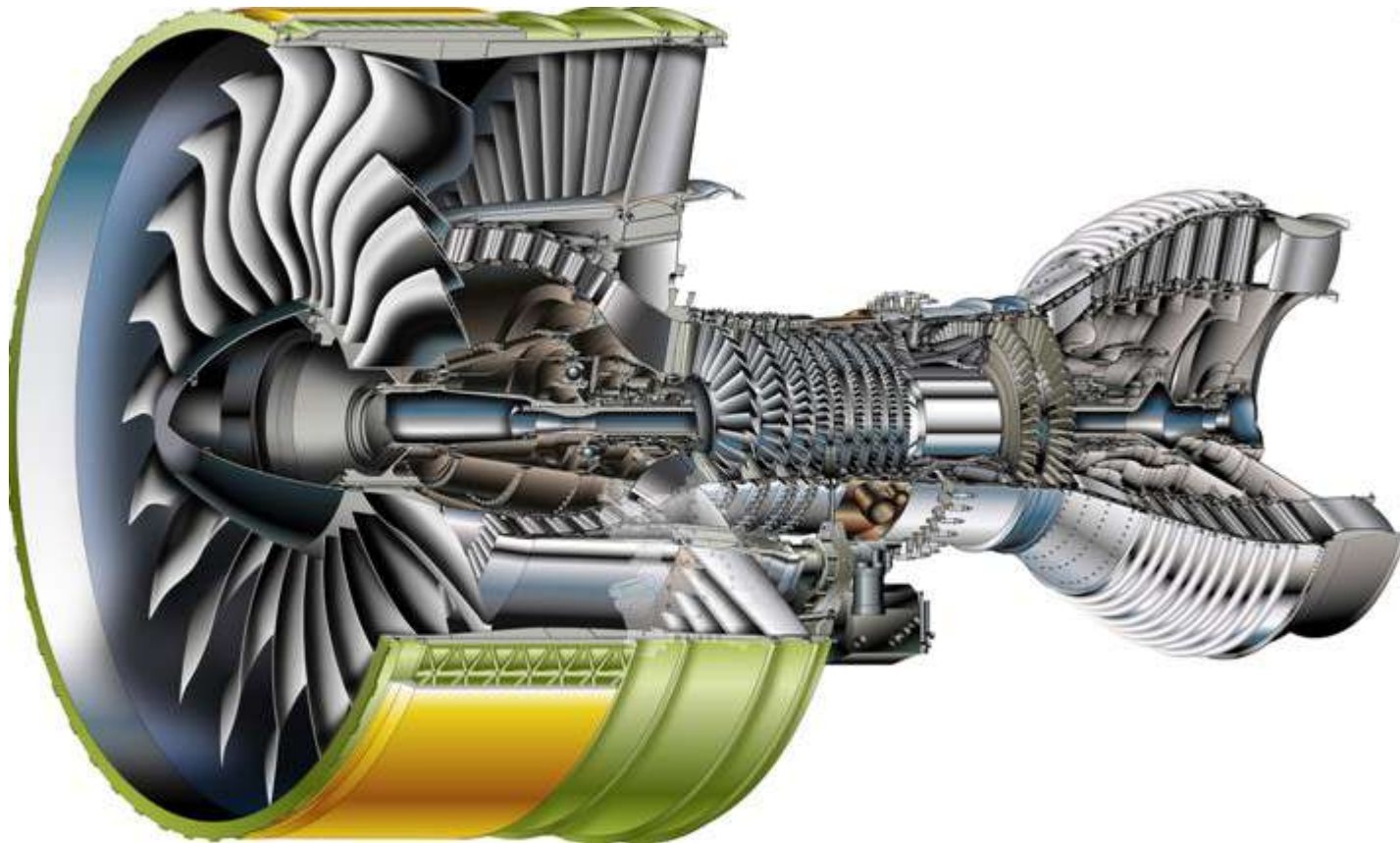# Alloys by design

Gareth Conduit, Bryce Conduit & Howard Stone

TCM Group, Department of Physics
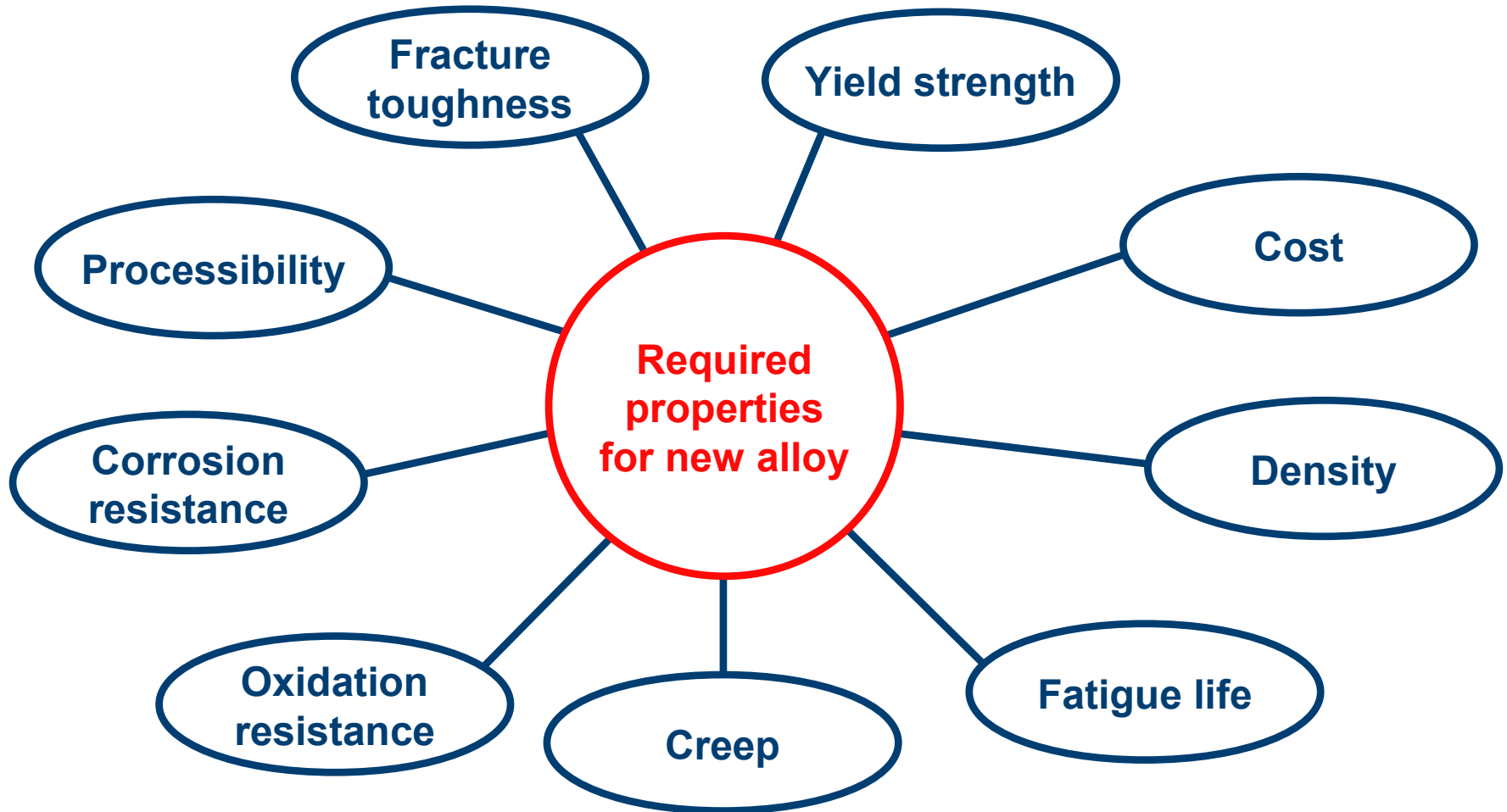
Jet engine turbine discs

Jet engine turbine discs

Designing a new alloy – what is required ?

Required properties for new alloy

- Fracture toughness
- Yield strength
- Cost
- Density
- Fatigue life
- Creep
- Oxidation resistance
- Corrosion resistance
- Processibility

Types of property models

- **For efficient development, predictions must take seconds or less**

  ✗ Experimental data (weeks/months)

  ✓ Neural networks (nano/micro seconds)

- **Combine estimates of individual properties to give overall probability of success**

Multidimensional design space

Cr	Co	Mo	W	Ta	Nb	Al
Ti	Fe	Mn	Si	C	B	Zr
Cu	N	P	V	Hf	Mg	Ni

and 4 different manufacturing processes

Selection of design space
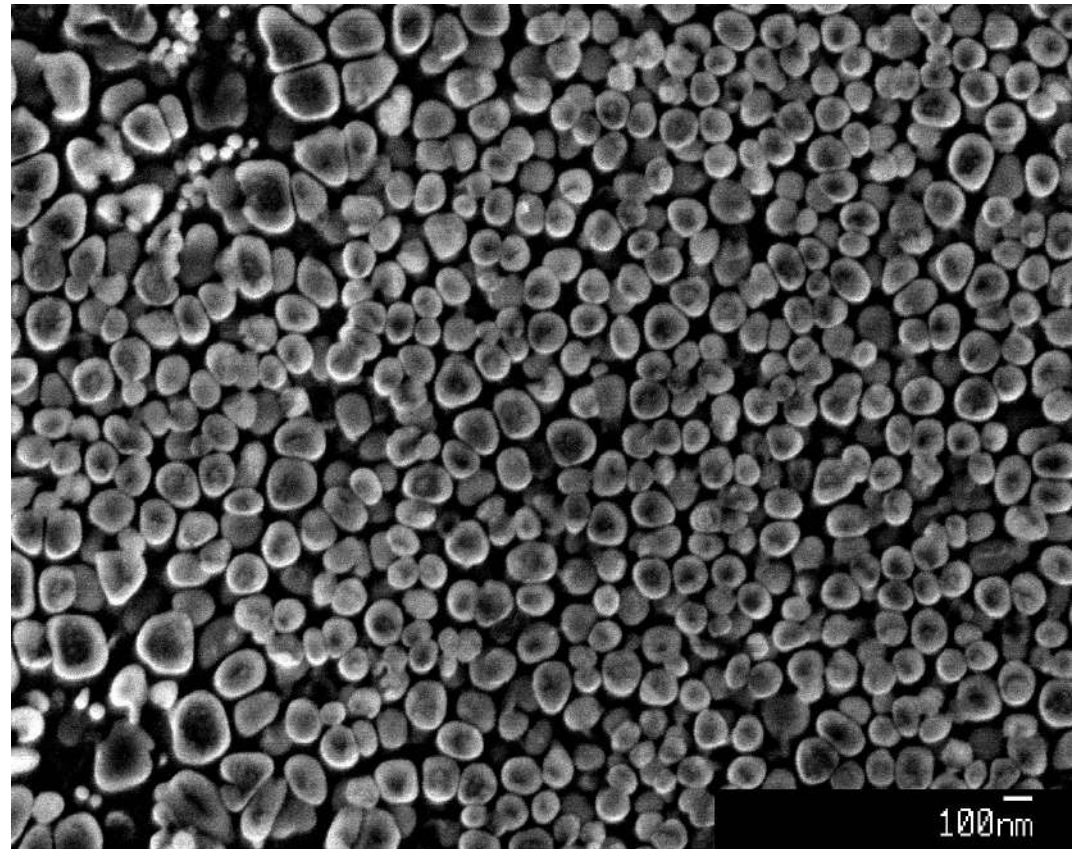
Selection of design space

Automated sampling - parallel optimization

Predicted material

- Arc melted, homogenised and heat treated according to model predictions

- Property assessment underway

Conclusions

- Have developed new ways to fully characterize a materials ability to fulfil several criteria

- Developed new algorithms to optimize a material's properties

- Manufactured proposed alloy with testing underway

- Generality of approach allows us to study other materials