

Fundamentals of Thermoelastic Stress Analysis

Análisis de concentradores de esfuerzo
Práctica 2 Diseño de Máquinas.
Grado en Ingeniería Mecánica

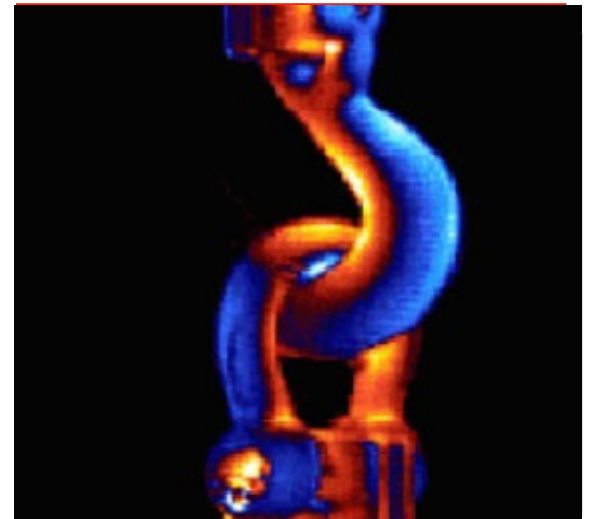


What is TSA?

- ✓ Non-contacting technique
- ✓ Full-field stress maps
- ✓ Temperature changes

Applications

- ✓ *NDE in aerospace industry*
- ✓ *Composite damage evaluation*
- ✓ *Crack analysis*
- ✓ *Contact stress distribution measurement*
- ✓ *Others: automotive industry, aerospace industry...*



Source Stressphotonics' website (2013)

The thermoelastic effect

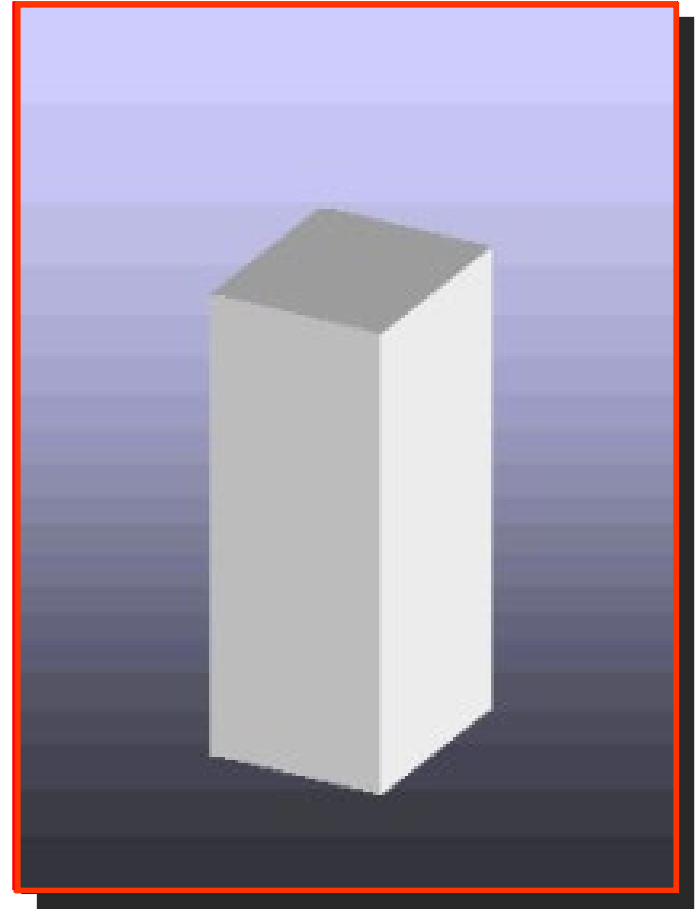
First reported by Lord Kelvin in 1853

....if cyclic loading is applied, then a change in temperature happens at the surface of the component

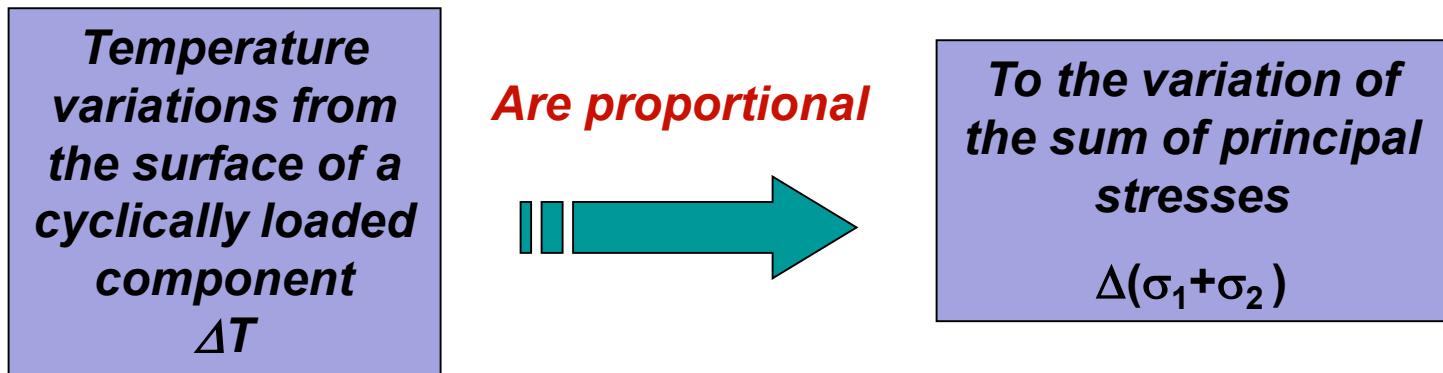
Under elastic conditions:

Increase in load = **cooling**

Decrease in load = **heating**

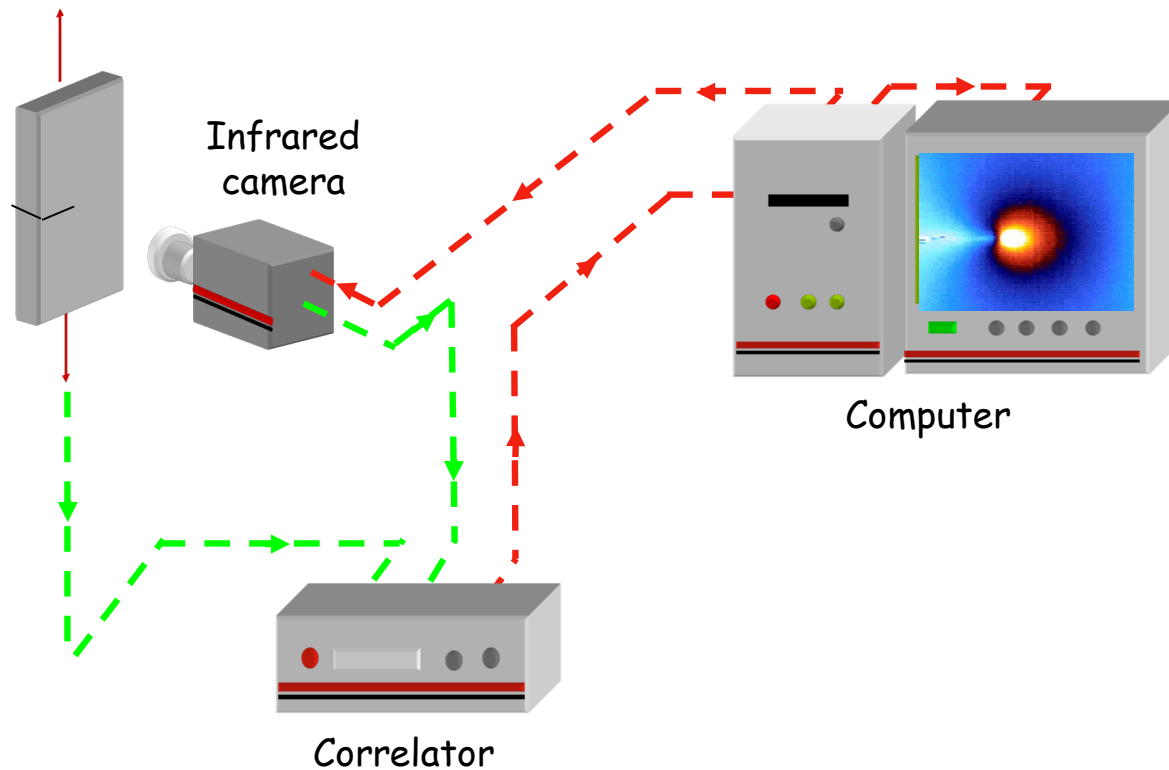


The thermoelastic effect



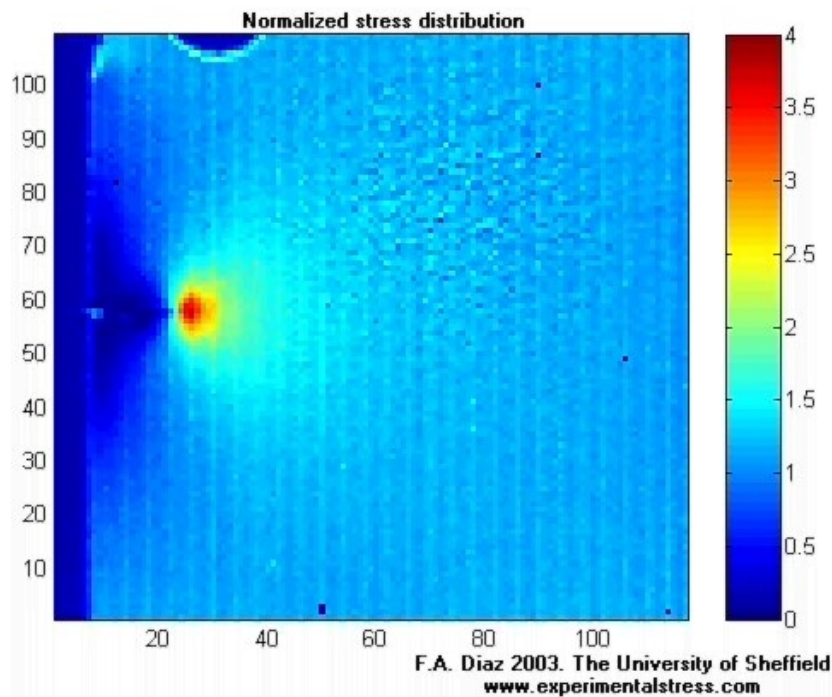
$$\Delta T = - \left[\frac{\alpha T}{\rho C_p} \right] \Delta(\sigma_1 + \sigma_2)$$

Schematic arrangement of the apparatus



Fatigue tests using TSA

2D distribution of the sum of principal stresses at the crack tip



3D distribution of the sum of principal stresses at the crack tip

