Cardan's formula

$$\begin{cases} I_1 = tr(A) \\ I_2 = \frac{1}{2}(I_1^2 - a_{ij}a_{ji}) \\ I_3 = \det(A) \end{cases}$$

$$\begin{cases} p = \frac{I_1^2 - 3I_2}{9} \\ r = \sqrt{p} \\ q = \frac{2I_1^3 - 9I_1 I_2 + 27 I_3}{54} \end{cases}$$

$$\theta = \cos^{-1}\left(\frac{q}{p^{\frac{3}{2}}}\right)$$

$$\begin{cases} \xi_1 = 2r\cos\frac{\theta}{3} \\ \xi_2 = 2r\cos\left(\frac{\theta}{3} + \frac{2\pi}{3}\right) \\ \xi_3 = 2r\cos\left(\frac{\theta}{3} + \frac{4\pi}{3}\right) \end{cases}$$

$$\begin{cases} \lambda_1 = \xi_1 + \frac{I_1}{3} \\ \lambda_2 = \xi_2 + \frac{I_1}{3} \\ \lambda_3 = \xi_3 + \frac{I_1}{3} \end{cases}$$

Strain:

$$\vec{u}(\vec{r}+d\vec{r}) = \vec{u}(\vec{r}) + \vec{\Omega}\cdot d\vec{r} + \vec{\Gamma}\cdot d\vec{r}$$
$$= \vec{u}(\vec{r}) + \vec{\omega}\times d\vec{r} + \vec{\Gamma}\cdot d\vec{r}$$

$$\begin{cases} \vec{\Omega} = \frac{1}{2}(\vec{u}\nabla - \nabla\vec{u}) \\ \vec{\Gamma} = \frac{1}{2}(u\nabla + \nabla\vec{u}) \\ \vec{\omega} = \frac{1}{2}(\nabla\times\vec{a}) \end{cases}$$

$$\varepsilon_{ij} = \frac{1}{2}(u_{i,j} + u_{j,i})$$

$$\varepsilon = \vec{\xi}\cdot\vec{\Gamma}\cdot\vec{\xi}$$

$$\varepsilon = \vec{\xi}\cdot\vec{\Gamma}\cdot\vec{\eta}$$

Thermal heat will only affect elongation, not shear.

$$\varepsilon_{ij} = \alpha(T - T_0)\,\delta_{ij}.$$

Volume dilation:

$$\Delta \equiv \varepsilon_{ii} = I_1$$