CERI 7105/8105
Global Seismology
Fall 2018
Homework Set #1
Due Wednesday September 12, 2018

Some MatLab or ObsPy practice:

1. Find the PREM500 and iasp91 earth models on the iris.edu website. Download each earth model and plot Vp and Vs as a function of Earth's radius such that the upper edge of the plot is Earth's surface and zero radius is at the bottom of the plot. (Plot Vpv and Vsv for the PREM model.) Label the major discontinuities and parts of the velocity models.

Einstein notation, strain and rotation:

2. Write out all of the terms for the following quantities:
   a. $a_k b_k$
   b. $c_{ij} d_{jk}$
   c. $\alpha_{ijk} \beta_{jk}$
   d. $\omega_{ij} \delta x_i \delta x_j$

3. Show that

$$\omega_{ij} \delta x_i \delta x_j = 0 \quad .$$

4. Show that (note the "*i*" subscript on the right hand side)

$$\delta u_i = \varepsilon_{ij} \delta x_j + \frac{1}{2} \left[(\nabla \times \vec{u}) \times \delta \vec{x} \right]_i \quad .$$

5. Show that

$$\delta V' = \delta V \left(1 + \varepsilon_{kk} \right) \quad .$$

6. Radial cylindrical displacement for a P wave is given by

$$\vec{q}(t,r) = a_P \frac{e^{-b^2\left(t-\frac{r}{\alpha}\right)^2}}{r}\hat{e}_r$$

where

$$r = [(x_1 - \xi_1)^2 + (x_2 - \xi_2)^2]^{\frac{1}{2}} .$$

Derive

a) $\frac{\partial \vec{q}}{\partial t}$

b) $\frac{\partial \vec{q}}{\partial x_1}$

and

c) Sketch $\frac{\partial \vec{q}}{\partial t}$. (<u>Do not</u> program this and make a plot – sketch.)