JKU Linz
Thomas Wick Oct 05, 2015

Exercise 1 - Numerical methods for fluid-structure interaction (Winter term 2015)

Exercise 1.1: Find yourself examples where fluid-structure interaction takes place in daily life or academic problems. What are characteristic properties in your example?

Exercise 1.2: In many applications, the deformation and displacements are infinitesimal small and thus Lagrangian and Eulerian frameworks can be identified (based on a first order approximation). Thus there is no need to distinguish between different coordinate systems. Let us justify this point of view in this exercise. Given $\|\nabla u\| \ll 1$, derive the linearized expressions for the deformation gradient F, its determinant J and the strain E.

Exercise 1.3: The material time derivative of an Eulerian field is a key quantity in continuum mechanics and later in fluid-structure interaction modeling.

– Let $f(t,x) : \mathbb{R}^m \to \mathbb{R}$ and $x \in \mathbb{R}^{m-1}$. Proof:

$$D_t f(t,x) = \partial_t f(t,x) + \nabla f(t,x) \cdot v(t,x),$$

where D_t denotes the total time derivative.

– Explain this formula in your own words.

Discussion of exercises: Oct 12, 2015