G-irreducible representations as a fundamental tool in Continuum Mechanics.

Classical continuum mechanics is founded on tensorial formalism. Both in its classical formulation,and in its diverse generalizations, tensors are involved. Up to second order, one can have physical intuition of what is the information described by tensors. But since third-order this intuition is lost…

In this lecture, the structure of higher-order tensors will be investigated. To that aim, and as usually done in biology lesson, dissection will be realized. But here, instead of a lancet, Lie groups will be used. More specifically, irreducible decompositions of tensors will be investigated underbothGL(3)- and O(3)-action.

As it will be shown the GL(3)-decomposition of a tensor is associated with the Tonti structure of the physical theories. Different type generalized continuum theories can be obtained by imposing constrained on that decomposition. Furthermore, compatibility equations, such as the St-Venant ones, are associated with thisdecomposition.

In a second time, the O(3)-decomposition of a tensor will be investigated. This O(3)-decomposition, also known as the harmonic decomposition, is the rigorous extension of the classical deviatoric decomposition used in mechanics. This decomposition is at the heart of the anisotropic modeling, both for linear and non-linear theories.