Communication Skills 1

Assignment 3: Critical Review

Written by: Mauricio Barrera **January, 2017**

Seminar title: "*Unified Kinematic Description of Geometrically Nonlinear Finite Elements*" (C.A. Felippa)

Professor Felippa addressed academics and graduate students of finite elements (FE) applied to solid mechanics problems. In his seminar, he proposes a new approach of the FE method and some developments of it to support his claim and raise interest in further studies.

He argues that there is lack of a general nonlinear FE procedure: at some point any software package has to focus on a specific region of the whole nonlinear phenomena.

The nature of the conventional nonlinear FE approaches (Total Lagrangian, Updated Lagrangian and Corotational Formulation) makes it complex, though possible, a general purpose, all-encompassing implementation. However, the programming effort entailed would mean a prohibitively high cost

Professor Felippa claims that using the Seth-Hill family of strain measures such generalisation could be developed at a reasonable implementation cost. This family provides an expression for uniaxial strain related to the stretch, whereby one parameter "m" could switch the strain between a series of measures commonly employed in the aforementioned conventional approaches to nonlinear FE. Based upon this, professor Felippa proposes an element called "Unified Kinematic Description Bar", and presents a benchmark problem to prove its consistency with results from the usual approaches. A promising development of this idea, currently in charge of one of professor Felippas' students, is its extension to a 2D element. By assembling a triangular structure with such bar elements, the strains would be taken as the readings of a strain gage rosette and then turned into the components of a 2D strain tensor. In this way, the 2D representation of any of the conventional strain measures could be readily obtained.

In my opinion, however, the argument of a rosette strain gage is an instance of reasoning by analogy: the conclusion that the measures taken from such device correspond to the 2D strain state at a point is valid so long as the gages are close together; also, the area they cover should be small compared with the size of the part analysed. In regards of professor Felippa's presentation, this means that the bar elements used to represent a 2D triangle should be similarly close together, so that the 2D strain state thereby produced is an acceptable representation of the modelled situation. The triangular elements thus derived would have to be small all over the analysis domain.

Nevertheless, future results from the work underway by professor Felippa's student, could well controvert this criticism's core premise.