Critical review of
Unified Kinematic Description Geometrycally Nonlinear Finite Elements presented by Professor Carlos A. Felippa, CIMNE-Barcelona, 2016

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Using an introduction of the origin of the NFEM (ASEN 6107-doctoral level), Felippa presented how the incremental solution method is born as the "Lagrangian" kinematic description (KD) appeared as milestones: Total Lagrangian (TL), Update Lagrangian (UL) and Corational (CR); and the corresponding transfer in to FEM codes as FEM programs (MARC, ANSYS, ABAQUS, NASTRAN, ADINA, STAGS, OPENSEES). These are the way to do the numerical analysis to solve "problems involving nonuniform heating and or large deflections […] in a series of linearized steps. Stiffness matrices are revised at the beginning of each step to account for changes in internal loads, temperatures, and geometrical configuration" since 1960. This presentation aimed to provide further information about the work out of each method. In TL is positive the extensive libraries, but cannot model truly large rotations (e.g. aircraft maneuvers, robotics); and fails for flow-like behaviour (e.g. metal forming).

Obviously there is a question: KD switches (flip-flap-flop)? The human cost gets in the way: $ 300 pro code line, upgrading (implementation + debugging + testing + documentation). It is not a small change.
Alternatively, if starting a new code of all three in a single FEM. Maybe. There are two useful concepts from nonlinear continuum mechanics that support maybe: stretch vs. strain and the Seth-Hill strain measure family.

First of all, bar element moving in 3D configuration for a single idea from physical stretch gages for the measurement to validate the method gives a way to get the implementation. Bar stretch (3D Motion) and the five finite strain measures (Green-Lagrange, Biot, Hencky, Swainger, Almansi-Hamel) for stretch λ=20% gives information between the methods differences. In 1964 B Seth proposed a 1D family with a measured index m (2, 1, 0, 1, -2) respectively. 1981 Rodney Hill extended the idea in 3D. Seth-Hill (SH) family present a table with the relationships between stretches to strains to get the Strain measures: good and weak points. Also is presented formally the Unified Kinematics Description (UKD) of the bar-element residual vector and tangent stiffness matrices worked out for NFEM.

With a Truss example shows the Mises Truss Load deflection diagram responses and the possibility of the assembly of the two methods for 2 nodes (Bar) and for 3 nodes (membrane triangle) moving in 3D. Through a simulation aimed to provide further evidence on the results of the implementation and the interaction of the methods, which is showing the behaviour of the implementation with the software Mathematica of 3D samples plotted with the interactive manipulation of the values measured.

Finally, there is evidence to do the unification procedures of the methods, which appear to be feasible for elements with nodal translations only.

In summary Further studies must be undertaken, better measures must be developed, and larger samples must be used to improve our understanding concerning the exact applicability of the KD method.