Congress on Numerical Methods in Engineering CMN2017
Valencia, 3-5 July, 2017

Energy-Entropy-Momentum integration schemes

D. Portillo*† and I. Romero†,*

* Technical University of Madrid
José Gutiérrez Abascal 2, 28006, Madrid, Spain

† IMDEA Materials
Eric Kandel s/n, 28906, Getafe, Spain

Email: david.portillo@imdea.org, ignacio.romero@upm.es

ABSTRACT

We present the basic theory for describing the formulation of time stepping algorithms that preserves the two laws of thermodynamis for dissipative problems. This work is based on the results presented by Romero [1] for finitite dimensional thermomechanical problems and later extended to infinite dimensional cases. The formulation of such methods is based on two ideas: expressing the evolution equation as a metriplectic system with the help of the so-called General Equations for Non-Equilibrium Reversible Irreversible Coupling (GENERIC) [2] and enforcing from their inception certain directionality and degeneracy conditions on the discrete vector fields. These methods can be applied to a vast class of thermomechanical systems as well as fluid dynamics, after realizing that they can be formulated as metriplectic models.

Numerical simulations verify the qualitative features of the proposed methods and illustrate their excellent numerical stability, which stems precisely from their ability to preserve the structure of the evolution equations they discretize

REFERENCES

[1] Romero, I, "Thermodynamically consistent time stepping algorithms for non-linear thermomechanical systems", *International Journal for Numerical Methods in Engineering*, 79(6):706-732 (2009)..

[2] Öttinger, H. C., *Beyond equilibrium thermodynamics*, Wiley (2005)..