SOME STANDARD FINITE ELEMENT DISCRETIZATIONS VIOLATE, NODALLY, CLAUSIUS POSTULATE OF THE SECOND LAW OF THERMODYNAMICS

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Abstract. The purpose of numerical methods is to resolve by discrete approximations physical phenomena described by continuous differential equations. However, by the very nature of discretization scheme, it may happen that certain physical principles which are present in the continuous become lost in the numerical scheme. Ignorance of the possible violation of these principles by the discrete approximation can be the source of major headaches for, both, programmers and users of numerical methods. The aim of this paper is to present some numerical observations about the fact that standard FEM numerical discretizations of the Heat Equation using linear elements can violate, nodally, Clausius Postulate of Classical Thermodynamics: meaning that sometimes heat can non-physically flow from low nodal temperatures to regions of higher nodal temperature.