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THE REGGE CALCULUS IN NUMERICAL RELATIVITY

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The Regge calculus has, to date, played only a minor role in the development of numerical relativity. This thesis is an attempt to redress this situation. It will be shown that the Regge calculus has the potential to be a powerful tool in the analysis of solutions of Einstein's equation.

The first chapter is included primarily to introduce certain fundamental notions and concepts associated with the Cauchy problem in its application to general relativity. It does not contain any essentially original material.

The emphasis in Chapter 2 is to develop a framework in which the kinematical aspects of the Regge spacetimes may be discussed. Explicit formulae for the metric, the connection and the Riemann tensor on a complex with a Lorentzian signature will be given. There will also be introduced a very convenient co-ordinate frame. This frame will be used extensively in Chapters 3 and 4.

The range of topologies that may be imposed upon a Regge spacetime is extremely broad. In Chapter 3 the Regge calculus will be formulated for a "3 + 1" topology. This will result in a formalism very similar to that of Arnowitt, Deser and Misner. Certain similarities between the Regge calculus and the ADM approach will be noted.

In Chapter 4 a variety of computer generated Regge spacetimes are

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presented. The examples are all cosmological solutions of the closed Friedmann type. They are worth investigation particularly since they require the resolution of two fundamental problems. The first is the way in which the action integral should be modified so as to apply to non-vacuum spacetimes. This problem is dealt with in detail in Chapter 3. The second problem concerns the interpretation of metrical symmetries on a Regge spacetime. This problem is investigated in Chapter 4.

The discussion in the final chapter concerns a number of points which may form the basis of a future investigation.

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