References on recent hyperbolic/alternative formulations in GR
updated June 13, 2002
Hisaaki Shinkai shinkai@atlas.riken.go.jp

References

[Reviews]  of course, I have not read them all.


[Initial Boundary Value Problem]  see also [Stewart]


[PIT3]  B. Szilágyi and J. Winicour, gr-qc/0205044 Well-Posed Initial-Boundary Evolution in GR

[ChoquetBruhat-York formulation]  a “symmetrizable” hyperbolic


Einstein and Yang-Mills theories in hyperbolic form without gauge fixing

Mixed elliptic and hyperbolic systems for the Einstein eqs

[AC96]  A. Abrahams and Y. Choquet-Bruhat, gr-qc/9601031. 
3+1 GR in hyperbolic form

Geometrical hyperbolic systems for GR and gauge theories

Well posed reduced systems for the Einstein eqs

A non-strictly hyperbolic system for the Einstein eqs with arbitrary lapse and shift

Hyperbolic formulation of GR

Einstein-Bianchi hyperbolic system for GR

Curvature-based hyperbolic systems for GR

Num. evolution of BHs with a hyperbolic formulation of GR

Treating instabilities in a hyperbolic formulation of Einstein's eqs

Causal propagation of constraints and the canonical form of GR

Fixing Einstein's eqs

Einstein constraints on asymptotically Euclidean manifolds

Einstein's eqs and equivalent hyperbolic dynamical systems

Num. Tests of Evolution Systems, Gauge Conditions, and Boundary Conditions for 1D Colliding Gravitational Plane Waves

Constraints and evolution in cosmology
Y. Choquet-Bruhat and J. W. York, gr-qc/0202014 (to appear in TMNA, volume in honor of A. Granas)

On H. Friedrich’s formulation of Einstein eqs with fluid sources

[Bona-Massó formulation] a flux-conservative form (a weakly hyperbolic)


Hyperbolic evolution system for NR


New formalism for NR


First order hyperbolic formalism for NR


The appearance of coordinate shocks in hyperbolic formalisms of GR


Three dimensional NR with a hyperbolic formulation


Pathologies of hyperbolic gauges in GR and other field theories


gr-qc/9902053

Robust evolution system for NR

[BP02a] C. Bona, C. Palenzuela, gr-qc/0202048

Explicit Gravitational Radiation in Hyperbolic Systems for NR

[BP02b] C. Bona, C. Palenzuela, gr-qc/0202101 (to be published in the Proceedings of ERE01)

Flux Limiter Methods in 3D NR

[Friedrich formulation]


On the regular and the asymptotic characteristic IVP for Einstein’s vacuum field eqs


The asymptotic characteristic IVP for Einstein’s vacuum field eqs as a IVP for a first-order quasilinear symmetric hyperbolic systems


On the hyperbolicity of Einstein’s and other gauge field eqs.


Hyperbolic reductions for Einstein’s eq.

[Friedrich98a] H. Friedrich, gr-qc/9804009 (Plenary lecture on mathematical relativity at the GR15 conference, Poona, India) Einstein’s eq and geometric asymptotics


Evolution eqs for gravitating ideal fluid bodies in GR

[Conformal Einstein Approach]
Num. treatment of the hyperboloidal IVP for the vacuum Einstein eqs. I. The conformal field eqs

Num. treatment of the hyperboloidal IVP for the vacuum Einstein eqs. II. The evolution eqs

III. On the determination of radiation

How to avoid artificial boundaries in the num. calculation of BH spacetimes

A scheme to numerically evolve data for the conformal Einstein eq

Num. Calculation of Conformally Smooth Hyperboloidal Data

From Now to Timelike Infinity on a Finite Grid

Problems and Successes in the Numerical Approach to the Conformal Field eqs

NR with the conformal field equations

a symmetric hyperbolic

First-order symmetric-hyperbolic Einstein eqs with arbitrary fixed gauge

The Cauchy problem and the initial boundary value problem in NR

NR and Inhomogeneous Cosmologies

a combination of Anderson-York and Frittelli-Reula and more (a symmetric hyperbolic)

Extending the lifetime of 3D black hole computations with a new hyperbolic system of evolution equations

Stability properties of a formulation of E-eq.

Exploiting gauge and constraint freedom in hyperbolic formulations of E-eq.


conformally-decomposed ADM formulation not a hyperbolic, but relatively stable. see also [YS01]
*Evolution of 3-dim. GW: Harmonic slicing case*

*On the num. integration of Einstein’s field eqs*

*A conformal hyperbolic formulation of the Einstein eqs*

*Well-posed forms of the 3+1 conformally-decomposed Einstein eqs*

*Towards an understanding of the stability properties of the 3+1 evolution eqs in GR*

*Towards a stable num. evolution of strongly gravitating systems in GR: The conformal treatments*

*Causal differencing in ADM and conformal ADM formulations: a comparison in spherical symmetry*

*Ill-posedness in the Einstein eq.*

[Miller] M. Miller, gr-qc/0008017  
*On the num. stability of the Einstein eqs.*

*Illustrating Stability Properties of NR in Electrodynamics*

[LS] P. Laguna and D. Shoemaker, gr-qc/0202105  
*Num. stability of a new conformal-traceless 3+1 formulation of the Einstein eq.*

[YS-BSSN] G. Yoneda and H. Shinkai, gr-qc/0204002  
*Advantages of modified ADM formulation: constraint propagation analysis of BSSN system*

[LSU-BSSN] O. Sarbach, G. Calabrese, J. Pullin, and M. Tiglio, gr-qc/0205064  
*Hyperbolicity of the BSSN system of Einstein evolution eqs.*

[Causal Propagation] Bel-Robinson tensor

*Very simple proof of the causal propagation of gravity in vacuum*

*Symmetric hyperbolic systems for Bianchi eqs*

*On the causal propagation of fields*

[Newtonian limit]
*On the Newtonian limit of GR*

*Fast and slow solutions in GR: The initialization procedure*

[dissipative system]

*Global existence and exponential decay for hyperbolic dissipative relativistic fluid theories*

*Stability of quasi-linear hyperbolic dissipative systems*

*On stability of conservation laws*

[Geroch01] R. Geroch, gr-qc/0103112
*On hyperbolic “theories” of relativistic dissipative fluids*

[λ-system] adding constraints in RHS of EoM, see also [SY99] and [YS00b]

*Einstein’s eqs with asymptotically stable constraint propagation*

*Effect of constraint enforcement on the quality of num. solutions in general relativity*

[constraint evolution]

*Evolution of the constraint eqs. in GR*

*Note on the propagation of the constraints in standard 3+1 GR*

*Constraint propagation in the family of ADM systems*

*A cure for unstable num. evolutions of single black holes: adjusting the standard ADM equations*

*Adjusted ADM systems and their expected stability properties: constraint propagation analysis in Schwarzschild spacetime*

[In the Ashtekar formulation]

*Einstein’s eqs in Ashtekar’s variables constitute a symmetric hyperbolic system*

*Symmetric hyperbolic system in the Ashtekar formulation*

*On the dynamics of Einstein’s eqs in the Ashtekar formulation*
Asymptotically constrained and real-valued system based on Ashtekar’s variables

Constructing hyperbolic systems in the Ashtekar formulation

Hyperbolic formulations and NR: Experiments using Ashtekar’s connection variables

Hyperbolic formulations and NR II: Asymptotically constrained systems of the Einstein equations

[should be categorized]

[Rendall00] A.D. Rendall, gr-qc/0006060 (proceedings of Journees EDP Atlantique)
Blow-up for solutions of hyperbolic PDE and spacetime singularities

The Einstein evolution eqs. as a first-order quasi-linear symmetric hyperbolic systems

Nonlinear wave eqs for relativity

Num. integration of nonlinear wave eqs. for GR

[Alvi] K. Alvi, gr-qc/0204068
First-order symmetrizable hyperbolic formulations of Einstein’s eq including lapse and shift as dynamical fields