Reading list

This is a very incomplete list of sources I regularly use.

Reviews

- Font, Numerical Hydrodynamics and Magnetohydrodynamics in General Relativity, Living Review. Last updated in 2008 but crucial background.
- Marti & Müller, Grid-based Methods in Relativistic Hydrodynamics and Magnetohydrodynamics, Living Review. SR only but updated in 2015. See also the original version from 2003.
- Balsara, Higher-order accurate space-time schemes for computational astrophysics—Part I: finite volume methods, Living Review. Very methods heavy. Cutting edge but not easy going.
- Baiotti & Rezzolla, Binary neutron star mergers: a review of Einstein's richest laboratory (arxiv:1607.03540). From 2017, specific to mergers.
- Shibata & Taniguchi, Coalescence of Black Hole-Neutron Star Binaries. From 2011, so somewhat dated: follow up by looking at Shibata's lengthy track-record in binary merger simulations.

Theses

- Radice, Advanced Numerical Approaches in the Dynamics of Relativistic Flows. From 2013, touches on a number of important technical details.

Books

- Leveque, Finite Volume Methods for Hyperbolic Problems, CUP. No astrophysics but one of the standard numerical methods texts.
- Hesthaven, Numerical Methods for Conservation Laws: From Analysis to Algorithms, SIAM. Still no astrophysics and even more mathematical-technical, but goes deep into methods like Discontinuous Galerkin and spectral elements which may be the future direction of the field.
- Rezzolla & Zanotti, Relativistic Hydrodynamics, OUP. From 2013, its focus is on hydrodynamics, not MHD. Lots of detail.
- Alcubierre, Introduction to 3+1 Numerical Relativity, OUP. From 2012, its focus is really vacuum relativity, but introduces hydrodynamics well from that viewpoint.

- Andersson, Gravitational-Wave Astronomy, OUP. Much more on the neutron star modelling, with some chapters on where the numerics fits in. From 2019.

Codes and tutorials

- Open Astrophysics Bookshelf. Relativity isn't a focus but the material covers a lot of numerics in great depth, with example codes throughout. Have a look at github.com/python-hydro for detailed examples in one and two dimensions.
- NRPy. A Python front end to a numerical relativity code, linked to Black-Holes@Home. Focus is on vacuum, but there are examples from GR(M)HD.
- Einstein Toolkit. A production GRMHD code that runs on massively parallel machines. There's a steep learning curve and it's designed to do a broad range of things (so it's more complex than it needs to be to do any *one* thing), but this can be used for real research.