Relativistic Models for Binary Neutron Stars with Arbitrary Spins
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abstract We introduce a new numerical scheme for solving the initial value problem for quasiequilibrium binary neutron stars allowing for arbitrary spins. The coupled Einstein field equations and equations of relativistic hydrodynamics are solved in the Wilson-Mathews conformal thin sandwich formalism. We construct sequences of circular-orbit binaries of varying separation, keeping the rest mass and circulation constant along each sequence. Solutions are presented for configurations obeying an $n = 1$ polytropic equation of state and spinning parallel and antiparallel to the orbital angular momentum. We treat stars with moderate compaction ($m/R_\infty = 0.14$) and high compaction ($m/R_\infty = 0.19$). For all but the highest circulation sequences, the spins of the neutron stars increase as the binary separation decreases. Our zero-circulation cases approximate irrotational sequences, for which the spin angular frequencies of the stars increases by 13% (11%) of the orbital frequency for $(m/R)_\infty = 0.14$ ($(m/R)_\infty = 0.19$) by the time the innermost circular orbit is reached. In addition to leaving an imprint on the inspiral gravitational waveform, this spin effect is measurable in the electromagnetic signal if one of the stars is a pulsar visible from Earth.