The aim of this thesis is the simulation of relativistic phenomena in post-Minkowskian approximation. In the introduction the terms of Mach principle and gravitomagnetism are presented. Afterwards the principles of numeric solution of ordinary differential equations are summarized. Consequently, we get acquainted with the first post-Minkowskian approximation in canonical formalism and with elementary examples of its use. In the next chapter the results of performed simulations of classical General Relativity tests are described. The last chapter is devoted to the simulation of gravitomagnetism and of the system of rotating particles.