This work is concerned with solving the Ernst equation using numerical techniques, namely pseudospectral methods. In theoretical chapters, we summarize the properties of some black-hole space-times. The work then cites the derivation of the Ernst equation and the Kerr solution. Afterwards we present pseudospectral techniques on the example of a numerical solution of the Laplace equation with a boundary condition at infinity. Finally we solve a non-linear differential equation, thus proving, that pseudospectral methods might be used even on the Ernst equation.