Nonlinear instability of some relative equilibrium configurations in the n-body problem

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We study by an analytical method, the second order non-linear stability of a degenerate configuration of a relative equilibrium where n bodies having the same mass m, are at the vertices of a regular polygon with n sides, while a body having a non-zero mass m_0 is at the center of the polygon. IT is shown that, at this configuration of the relative equilibrium, the matrix of the second derivatives of the energy-momentum functional has always negative and positive eigenvalues, for any choice of n and any choice of the ratio $\mu = m_0/m$ Consequently the above configuration is nonlinearly unstable for any choice of and n, even if for n ¿ 6 it is linearly stable for larger than some third degree polynomial of n, as we had shown in a previous paper.