

Analytical-approximate solution of Abel integral equations

Abstract

It is known that Abel integral equation has a solution in a closed form, with a removable singularity. The presence of Volterra integrals with weak singularity is not always integrable for continuous differentiable class of functions. In this work we propose an analytical approximate method for the solution of Abel integral equations. We showed that the proposed method is exact for the known function in the cases of polynomials and irrational function of the form $f(t)t^{\alpha+1}(a_0+a_1t+\dots+a_nt^n)$, $0<\alpha<1$. For the derivation of the proposed method we expand the known function to the Taylor series around a singular points. Substituting this expansion into the solution of Abel equation we could remove the singularity. All evaluations of the integrals are calculated analytically. The obtained solution is a series that is uniformly convergence to the exact solution.

Keyword: Abel integral equation; Weakly singular integral; Taylor expansion; Approximate solution