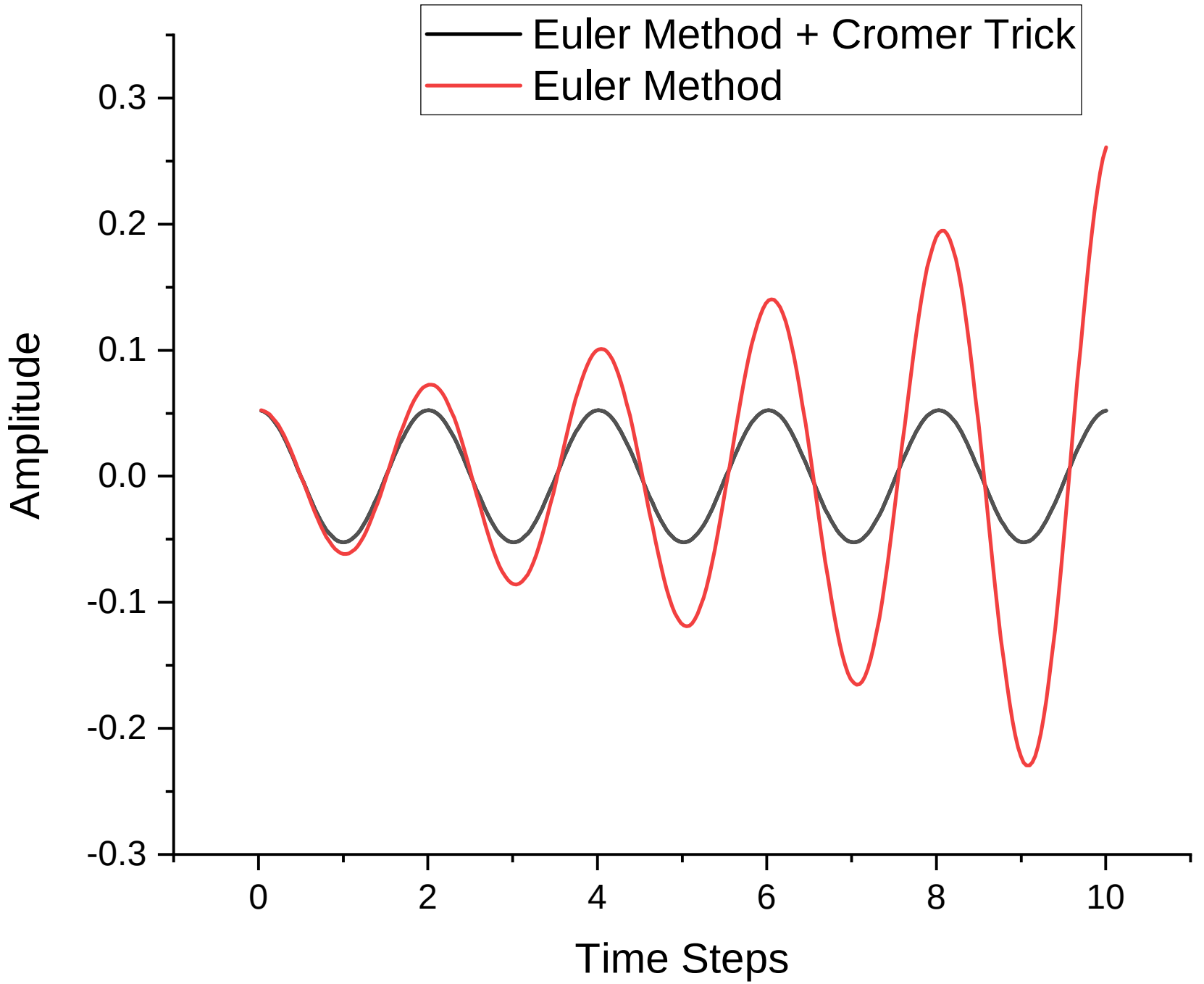
In this project we showed that direct application of Euler method to solving the harmonic oscillator equation leads to amplitude diverging as time steps progress. This is because the Euler method truncates the terms in the solution, which, in turn means that the total energy of the system increases. This forms a feedback loop that leads to gradual raising of the total energy of the system, when, in reality, the total energy of the pendulum has no reason to increase and stays constant, provided that the damping and driving forces reach an equilibrium.

The solution of this problem lies in the augmentation of the Euler method with the Cromer method, known as Euler-Cromer method. The trick of this method lies in the fact we track both the equation for the position of the particle and the equation for the velocity of the particle. Then, we first update the equation for the velocity of the particle and use the updated value for the velocity of the particle in the calculation of the new position. This tends to conserve the total energy of the system and produces good numerical results, which can be seen on the graph from the comparison between the two methods.


Euler Method + Cromer Trick
Euler Method
Amplitude
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
0
2
4
6
8
10
Time Steps