Deviation from MBC under slow oscillations

#2D #circular_island #mbc

Here we ran simulations of the 2D TDGL equation considering the initial state to be a circular island of radius R_0

$$u(x, y, t = 0) = \tanh\left((R - R_0)\sqrt{\frac{1}{2}}\right)$$

we considered the simulation box lenght $L = 204.8$ and $R_0 = 25$ such that there is no interaction between opposite kinks due to the PBC conditions.

Resumee

The correction to motion by curvature of $\dot{R}$ depends only on the value of $C(t)$ if R is large, but in a different fashion than $\partial_t d$ for two kinks in 1D.

Measuring the radius

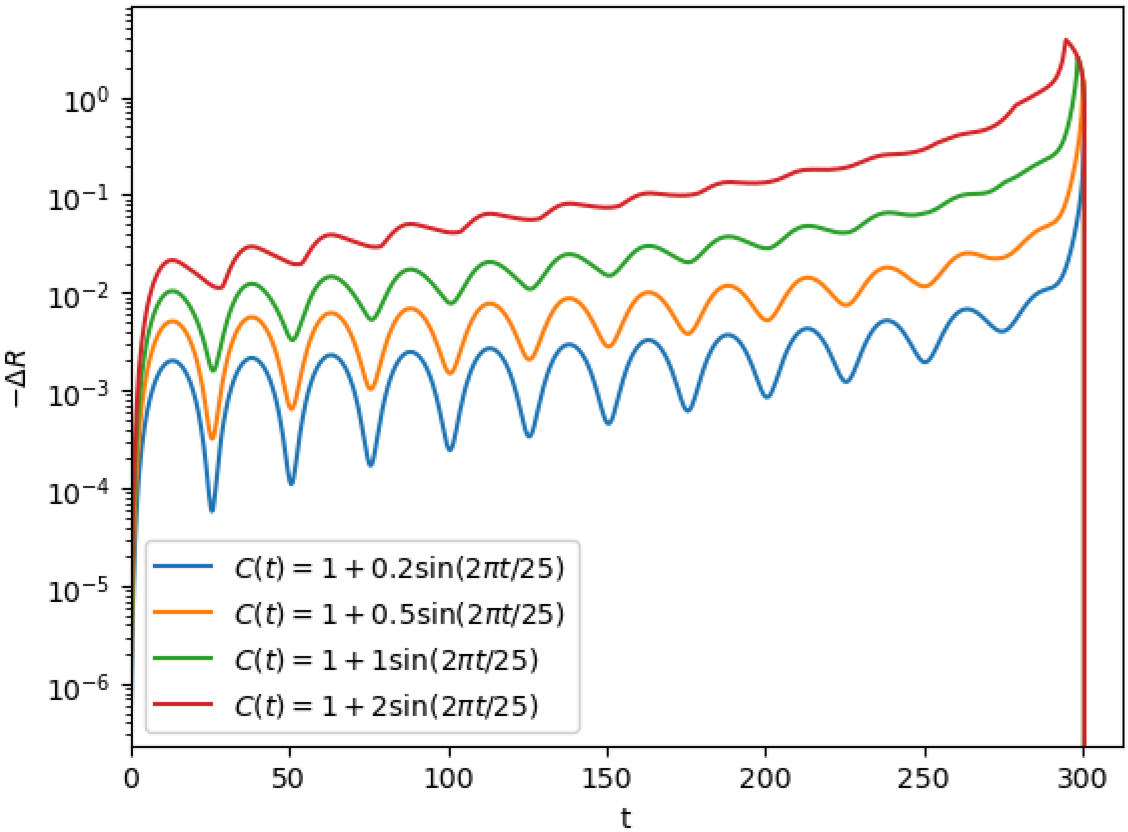
The radius, as a function of time $R(t)$, has been measured by looking at the sections of $u(x, y)$ along an horizontal and a vertical lines passing through the origin (that is the island's center). Then the distance is measured as we measure the distance between two kinks in 1D (the distance between the zeros of the function, where the zeros positions are estimated with a linear interpolation, **to avoid steps** in $R(t)$)

Measuring the deviation from the constant case

We define the deviation from a simulation where $C = 1$ constant as

$$\Delta R = R_{C(t)} - R_{C=1}$$

Deviation is enhanced if C is close to zero or negative



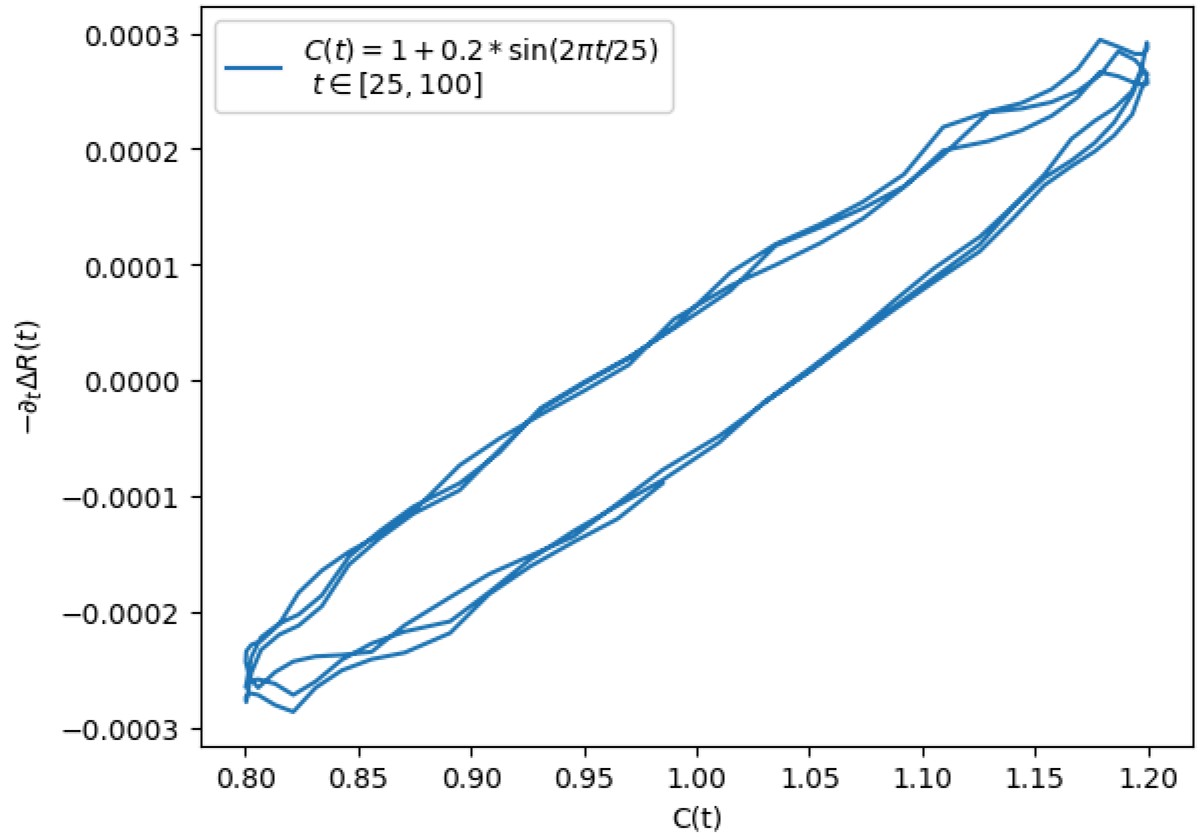
Does the deviation of the Radius behave like the distance of two kinks in 1D?

For two kinks in 1D, we've found that if the oscillations are slow and positive

$$\partial_t d \sim C(t)^{1/2} e^{-dC(t)^{1/2}}$$

as, if we take a section of the island we find a 1D system with two kinks, it's reasonable to expect that **the next order effect to MBC** is a decay of this kind of the diameter.
If we plot minus the time derivative of the radius deviation ΔR as a function of C, we see this kind of **trajectory**. This is different from what we see in 1D!!!

- The time derivative can get both positive an d negative values, leading to oscillations in ΔR
- The trajectory is **symmetric**: it behaves in the same way when C is close to its smallest or biggest value (except for a sign).



Considering a larger time interval, the trajectory changes.
I think this is due to the fact that there are corrections to MBC $\sim \frac{1}{R^2}$

$$\dot{R} = -\frac{1}{R} + O\left(\frac{1}{R^2}\right) + O(\epsilon^2)$$

and at large time the radius becames small, so these corrections become relevant. Those corrections are present **also** in the data with constant C (which is **subtracted** to the data with oscillating C), but as $R_{C(t)}(t) \neq R_{C=1}(t)$ (the two curves are different), then also the correction to MBC it is!