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Home work 2B

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# Home work 2B

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# Homework 2-B

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Students,

Does anyone solve this homework?

I didn't understand what function i should solve? d (psi)/dx=sqrt(K*L^2-1) K=1,L=2, therefore Psi=constant

Markelov Igor
on Thu 11 Oct 2012 7:32:09 PM CEST

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What I understood so far:

1. We should to solve our quantum oscillator equation $\frac{\delta^2\psi}{\delta x^2} - (Kx^2 - \epsilon_n)\psi = 0$, where $K = 1$, $\epsilon_n = \epsilon_1 = 1, x \in [-L, L]$, where L=2.
2. The conditions at $x = -L$ are: $\psi(-L) = 1$, $\frac{\delta\psi}{\delta x}(-L) = \sqrt{K * L^2 - \epsilon_n}$
3. We should to use $odeset$ to change the "RelTol" and "AbsTol" parameters
4. We should obtain "average step-size" from the ode procedure and undsrestand how it depends on tolerance.

Here they lost me.

A. What is the "average step-size" and how it can be obtained from the ode procedure? It is not step in $x$ or $y$ arrays - they have fixed step; it should be some inner aray used by the procedure. It should be an array because they asked us to use $diff$ and $mean$

B. What is the step in the xspan? Is it [-L:0.1:L] or [-L L]?

C. And what is $\gamma = 0$?. But it is probably not important.

Update:

A, B: We must use xspan in form [-L L]. In this case ode procedure itself allocates adaptive mesh. And $diff$ and $mean$ should be applied on x.(Thanks to Mikhail Garasyov)

C. $\gamma = 0$ is not important. We know exact form of boundary conditions at -L: [1 sqrt(...)]

5 After getting the average step size for tolerance = $10^{-4}$ we need to repeat all the steps 1-4 for all given values tols=$10^{-4}\ldots10^{-10}$. That will give us 2 arrays of size 7 "tols" and "step-size"

6 We need to convert these 2 arrays "tols" and "step-size" into logarithmic form using log() (or log10()) function. Then we can calculate slope using polyfit(steps, tols, 1). That will give us answer for Q1

7 Finally we need to repeat steps 1-6 for all given forms of ode procedure.

8 Feed the result to grader and voila - 4/4

Constantin Fishkin (Student)
on Fri 12 Oct 2012 8:58:10 PM CEST

**Comments**

4 A. Built-in ode creates adaptive mesh if you use xspan = [-L L] and adds new points if the error is bigger than the required tolerance. After the calculation just look at the number of x points. This will give you average step size. C. Maybe $\gamma = 0$ is something important because I received only 2 values accepted by the grader =)

Mikhail Garasyov (Student)

0 Hi Mikhail, please let us know the values that you are obtaining including the values that are not accepted by the grader. Many thanks.

lucas ochoa

4 Great, thank you! Good to know, I used [-L:0.1:L] and did not see any difference in X of course. So I thoght we can obtain inside mesh somehow

Constantin Fishkin (Student)

4 Para Lucos:

cinco . veinte cuarenta y ocho dos . noventa y nueve ochenta y cuatro once . cincuenta treinta y ocho siete . uno uno noventa y dos

Constantin Fishkin (Student)

*This comment has been deleted.*

1 Hola Constantin, muchas gracias, tus valores son los aceptados por el grader. Sería fantástico que compartieras tus resultados con todos los estudiantes. Un saludo muy especial desde Colombia.

lucas ochoa

*This comment has been deleted.*

*This comment has been deleted.*

Response to C.Fishkin's comment,

0

(A) Remember that the ODE45 (and others) returns a vector of the points on the x-axis that it used to reach the specified tolerance.

(C) The gamma in the given conditions pertains (I think, looking at my notes from Video 3.1) to this equation... alpha*y(a) + beta*y'(a) = gamma If y(a) = y(-L) = y(-2) = 1 (given), and y'(a) = y'(-L) = y'(-2) = sqrt(K*L^2-1) = sqrt(3) (given). So the equation becomes alpha + beta*sqrt(3) = gamma = 0. But do we care what alpha and beta are as long as we have y(a) and y'(a)?

Eric Pittelkau

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Part of the fun of these homework assignments is figuring out what we're supposed to calculate. I take it that the directive "save the results in (f)-(i)" is not applicable to what we're supposed to do? Do we calculate a 1st order fit to the loglog plot? Then I think Questions 1, 2, 3, and 4 pertains to ODE45, ODE23, ODE113, and ODE115. Can someone confirm?

Naturally, my first attempt was 0/4. What does this refer to? "Note that the local error should be [$O(\Delta t^5)$] and [$O(\Delta t^3)$] respectively. "

Eric Pittelkau
on Sat 13 Oct 2012 5:44:05 AM CEST

**Comments**

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ode45: Has a global error of order $O(\triangle x^4)$ and a local error of order $O(\triangle x^5)$

1

ode23: Has a global error of order $O(\triangle x^3)$ and a local error of order $O(\triangle x^3)$

Hence you should get slopes close to 5 and 3 for these 2 methods from the polyfit command.

**Meghana Velegar (Staff)**

Edit: ode23: Has a global error of order $O(\triangle x^2)$

0

**Meghana Velegar (Staff)**

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Please view the assignment page again, the answers should be stored in (a)-(d). These are the slopes you get using polyfit for ode45, ode23, ode113 and ode15s respectively. In response to the questions raised:

A. What is the "average step-size" and how it can be obtained from the ode procedure? It is not step in x or y arrays - they have fixed step; it should be some inner aray used by the procedure. It should be an array because they asked us to use diff and mean. B. What is the step in the xspan? Is it [-L:0.1:L] or [-L L]?

**As mentioned above (Thanks to Mikhail Garasyov), using [x_out, y_out] = ode45('function',xspan,....) with xspan=[-L L] gives the in-built MATLAB ode solvers the freedom to choose their own grid spacing or step size $\triangle x$, such that the required tolerance is satisfied. As an output, the solvers then return the grid thus created in x_out. You can then use mean(diff(x_out)) to see what the "average" grid spacing used by the solver was. As you work on this problem, please note whether the different ode solvers use a fixed or variable grid**

**spacing - and which ode solver was the most "efficient" for this problem**

C. γ=0 is not important. We know exact form of boundary conditions at -L: [1 sqrt(...)] **Correct!**

**Meghana Velegar (Staff)**
on Tue 16 Oct 2012 2:27:35 AM CEST

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Here is a summary of steps:

(1) Set L = 2, xdomain = [-L L], $\epsilon_n = 1$, and the initial values at $x = -L$ as defined, i.e. $\phi_n(-L) = 1$ and the corresponding value for $\frac{d\phi_n}{dx}$ at $x = -L$

(2) Define the tolerance values (TOL = 1e-4 ... 1e-10).

(3) For each tolerance value get the mean step size used by the odesolver

(4) Find the slope of the log-log plot of tolerance v/s average step size

Repeat for each ode solver. Don't worry about setting $\gamma = 0$, since we have only used the linear version of the ODE in the assignments for Quantum oscillator.

Hope this helps!

**Meghana Velegar (Staff)**
on Tue 16 Oct 2012 2:44:52 AM CEST

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