6. Allow the rider to move along the zipline

Understanding the code generally

MIT180312016-V027900

0:00 / 6:04

Speed 2.0x

Video

Download video file

Transcripts

Download SubRip (.srt) file

Download Text (.txt) file

Note on video: The code we are providing you actually uses a Runga–Kutta 4th order method rather than ODE45. This was to optimize the plotting of the solution, but the underlying principles are the same.

We have written some MATLAB code that models a moving rider along a zipline. Here are instructions for downloading and running the code.

1. Login into MATLAB Online using your license from this course (or use a desktop versionR2016b or later).

2. Navigate the Current Folder browser to where you want to save the file.

3. Copy and paste the following code in the MATLAB to download the scripts.

```
url = 'https://courses.edx.org/asset-v1:MITx+18.033x+1T2018+type@asset+block@plotCat.m';
websave('plotCat.m', url);
url = 'https://courses.edx.org/asset-v1:MITx+18.033x+1T2018+type@asset+block@zipRHS.m';
websave('zipRHS.m', url);
url = 'https://courses.edx.org/asset-v1:MITx+18.033x+1T2018+type@asset+block@startPos.m';
websave('startPos.m', url);
url = 'https://courses.edx.org/asset-v1:MITx+18.033x+1T2018+type@asset+block@catSys.m';
websave('catSys.m', url);
url = 'https://courses.edx.org/asset-v1:MITx+18.033x+1T2018+type@asset+block@zipsys.m';
websave('zipsys.m', url);
```

4. Open the **zipsys.m** file. Try running this code for a zipline rider that weighs 1kg and one that weighs 100kg. (You will need to edit the parameter **p.m** in the zipsys file.) Observe that when the mass of the rider is very small, the trajectory is very close to the catenary. And when the mass is large, it approaches the ellipse.

The output of this code will be two graphs. The upper plot shows a parametric plot of the trajectory of the rider in blue. The lower plot shows the velocity of the rider as a function of time.

The code is written to stopy running once the position of the rider reaches 450, or the time step is larger than 100.

Designing a zipline

2 points possible (graded, results hidden)

You are designing a zipline. You will allow for young riders and adult riders whose weights range between 30kg and 100kg. The two trees you have decided to run your zipline between are 500 meters apart. The end of the zipline ride ends at a landing pad at the 450 meter mark. You set up the zipline with 3 meters of slack in the cable.

(Note that the code is set up to stop running once the rider has reached the 450 meter mark.)

Question 1: Your goal is to determine the smallest value of the total vertical drop H between the two end points of the cable (to the nearest meter) that guarantees that your lightest riders make it to the landing pad (which is at 450 meters from the left end point).

(Enter to the nearest meter.)

$H =$ 39 meters

Question 2:

In the previous question, you found the difference in heights between the left and right end points of the zipline. How high off of the ground should the right end point be to ensure that both light and heavy zipline riders don't hit the ground at the lowest part of the trajectory? (For safety, add 3 meters to leave room for very tall people!)

(Enter to the nearest meter.)

17 meters

Submit You have used 1 of 10 attempts

Answer submitted.

Acknowledgements

We would like to thank Timothy Hall for asking David Jerison the question, "how do ziplines behave mathematically?" We would also like to thank David Custer and Susan Ruff who helped with real life ziplines and shared MIT student experiments on ziplines. Big thanks to Prof. Ken Kamrin for writing the original MATLAB code that solves the zipline model, and Miles Couchman for designing this project.

6. Allow the rider to move along the zipline

Hide Discussion

Topic: Final project: Applications to nonlinear differential equations / 6. Allow the rider to move along the zipline

Add a Post

Show all posts ▼ by recent activity ▼

? error in video? 2

2^nd question clarification
I've a few doubts about breaking down the second question: while we rise the height of the right end point to guarantee that no rider will hit the ground, do we also rise the h... 3

Thanks for this extraodinary example
Just a moment to point out this wonderful example where we apply matlab, ODE systems and pure mechanical theory all together. Bravo for this course! Again, MITx at the T... 1

Nearest next integer or roundoff?
if, for Q1, i get something like 12.4, should i put 12 or 13? 4

Height of right end point
Cool problem -- at least for me, it required an understanding of the program to be able to set the right endpoint height and optimize it per the instructions. But maybe I did it ... 2

Vertical Drop H
In the code provided , i have tried adjusting mass in given range in increments of 5 but keeping the rest parameters fixed .Even for 100 kg ,rider does not reach 450 m (landin... 5

licensing issue
FYI i get a licensing issue for the Optimization Toolbox using my Edx related matlab license. The script wont run as a consequence. The error in particular is - To use 'optimopti... 6

© All Rights Reserved