A strange effect of physics

Synchronization of metronomes

Yongi Kim

Contents

1 Background and Objective

Synchronization around us is confirmed just as a physical phenomenon but its principle is not clear.

We are trying to analyze it.

1 Background and Objective

For example…

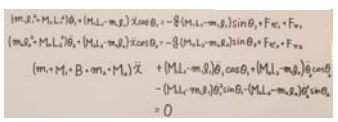
3 Experiment

3 Progress

Analyze the experiment

Demonstrate by mathematics and

Simulate on the computer



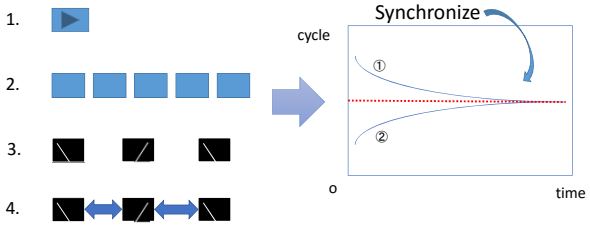
3 Progress (analyzing the experiment)

We are trying to make a program as follows

1. Divide the video of the experiment into the pictures of the frames
2. Binarize them and analyze the cycle of the metronomes
3. Examine the change of the cycle

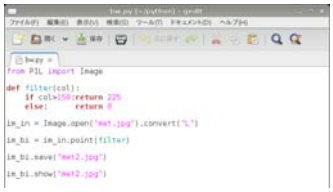
3 Progress (analyzing the experiment)

3 Progress (analyzing the experiment)

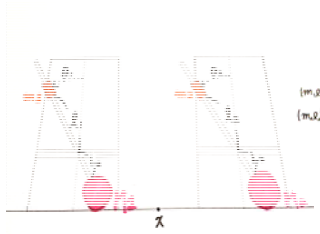


3 Progress (analyzing the experiment)

We are making a program like this. It is incomplete yet.



3 Progress (demonstration by mathematics)



Fばね:force of the spring
F摩 :frictional force

$$(m_1 g L_1 + M_1 L_1 l)\theta_1 + (M_1 L_1 - m_1 g_1)\ddot{x}\cos\theta_1 = -g(M_1 L_1 - m_1 g_1)\sin\theta_1 + F_{\theta_1} + F_{v_1}$$

$$(m_2 g L_2 + M_2 L_2 l)\theta_2 + (M_2 L_2 - m_2 g_2)\ddot{x}\cos\theta_2 = -g(M_2 L_2 - m_2 g_2)\sin\theta_2 + F_{\theta_2} + F_{v_2}$$

$$(m_1 + M_1 + B + m_2 + M_2)\ddot{x} + (M_1 L_1 - m_1 g_1)\theta_1 \cos\theta_1 + (M_2 L_2 - m_2 g_2)\theta_2 \cos\theta_2 - (M_1 L_1 - m_1 g_1)\theta_1^2 \sin\theta_1 - (M_2 L_2 - m_2 g_2)\theta_2^2 \sin\theta_2 = 0$$

4 Future Work

- Compare the results of analyzation and demonstration
- Try other synchronizations
- Test Lagrange for this over other synchronizations

References

龍谷大学理工学部数理情報学科2012年度卒業論文
“メトロノームは本当に同期するのか”
三崎洋平
指導教員 池田勉

My teammates

Taishi Kumagai, Soudai Tanaka, Syunji Hagimori, Souma Hattori, Kazunari Yamakawa

Question 1

• What is the name of the equation we used?

a) Lagrange equation
b) Laglarge equation
c) Lagrarge equation
d) Laglange equation

Question 2

• Which is Soudai Tanaka(one of my teammates)?

a) b) c) d)