**Ball and Beam Experiment Report**

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**Experiment Result**

1. **Calibration**

**(1)position**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Position | -30 | -10 | 0 | 10 | 30 |
| Voltage | 5.6 | 4.7 | 4.26 | 3.78 | 2.8 |
| a=-21.445 b=90.668 | | | | | | |

**(2)Angle**



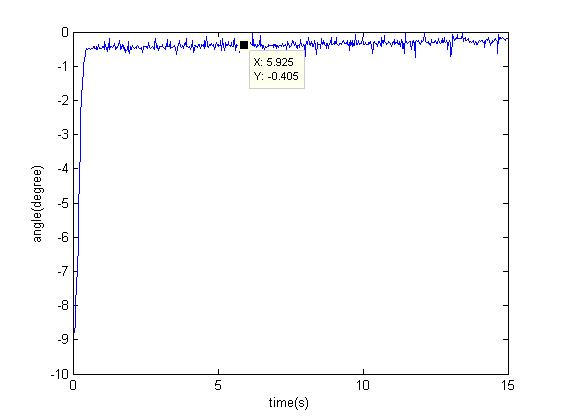
→ a= 32.258 b= -104.52

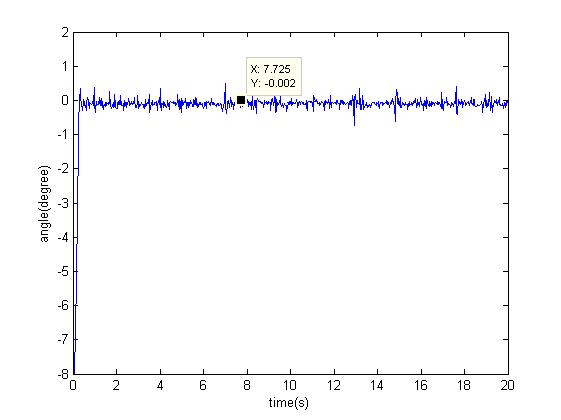
**2. Beam Angle Control**

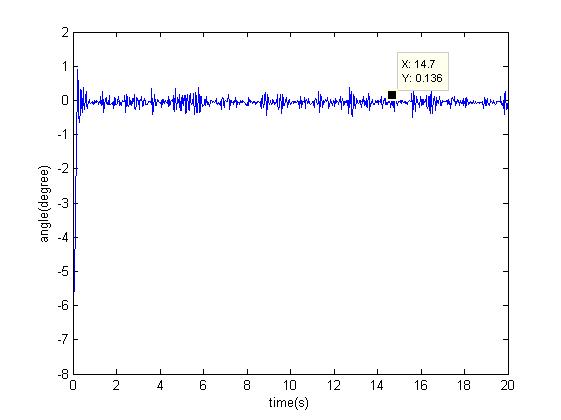
(1) Desired angle is 0. Please Record the Steady-error and the data in different 

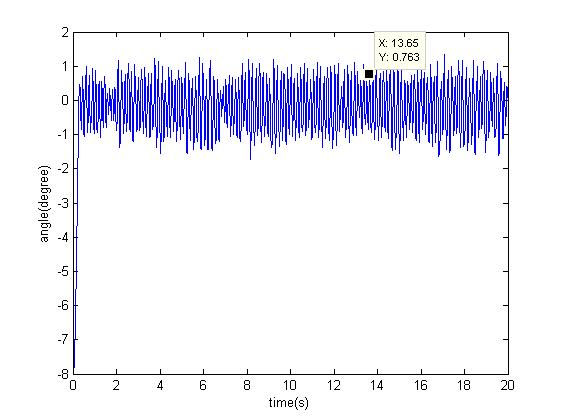
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 3 | 5 | 7 | 15 | 20 |
| Steady-error | 0.405 | 0.002 | 0.136 | 0.763 | 0.975 | 1.107 |

(2)Data Plot

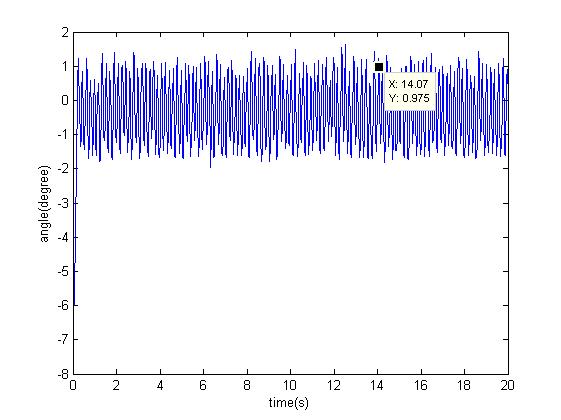


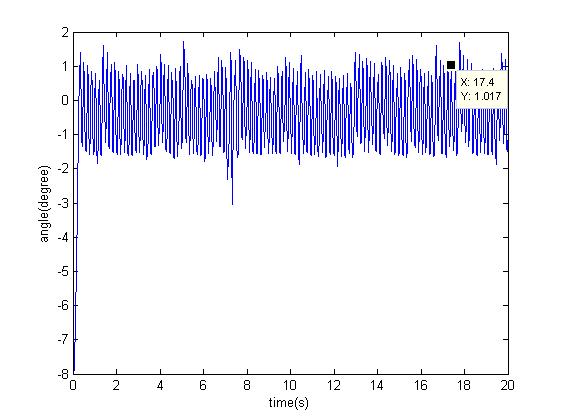






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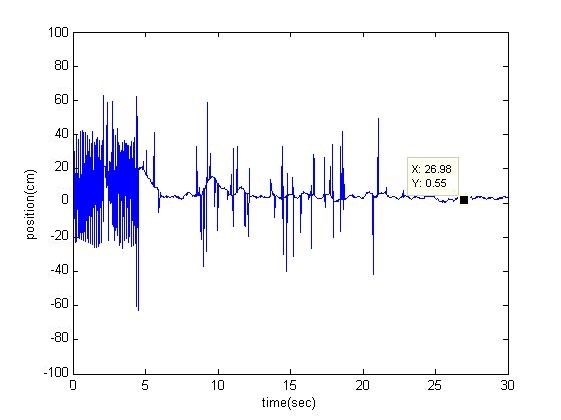
**3. BALL AND BEAM EXPERIMENT - PART I**

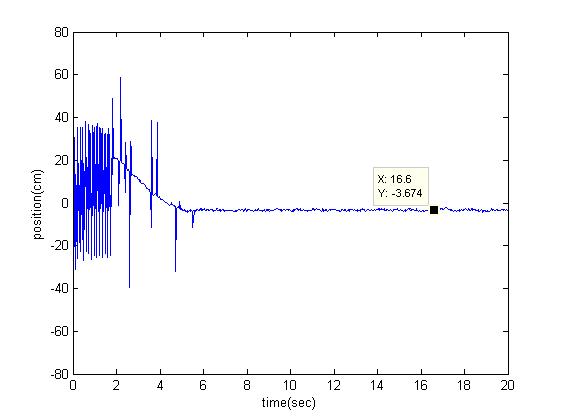
(1) Find the parameter  of the control ,with different damping ratio  and natural frequency 

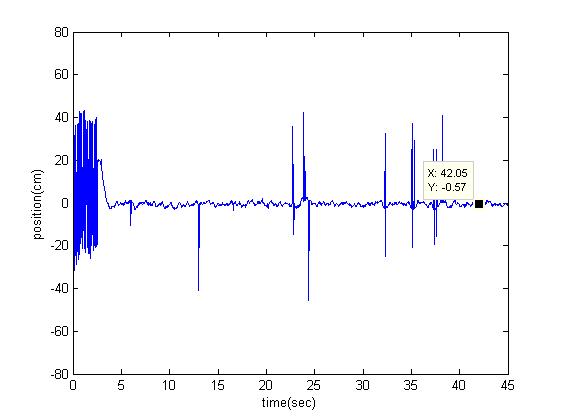
|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | 0.92 | 0.612 |
|  | 0.1 | 0.144 |
|  | 0.92 | 0.433 |
|  | 0.1 | 0.1 |
|  | 0.92 | 0.31 |

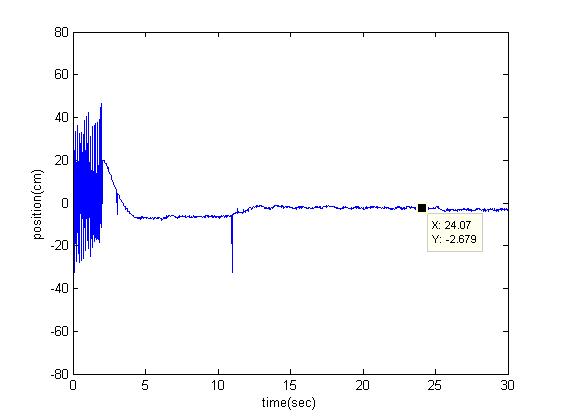


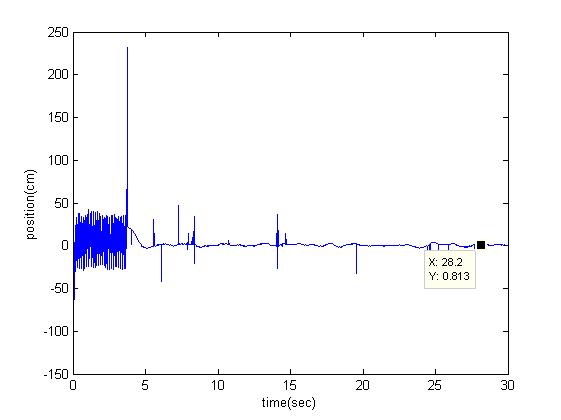
(2) Desired position is 0 cm. Set up all the parameter and plot the performance data.











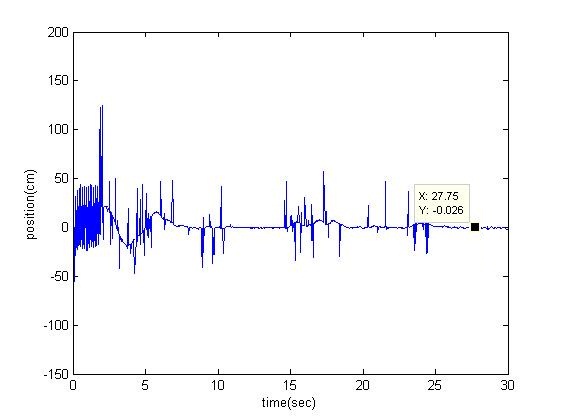
**4. BALL AND BEAM EXPERIMENT - PART II**

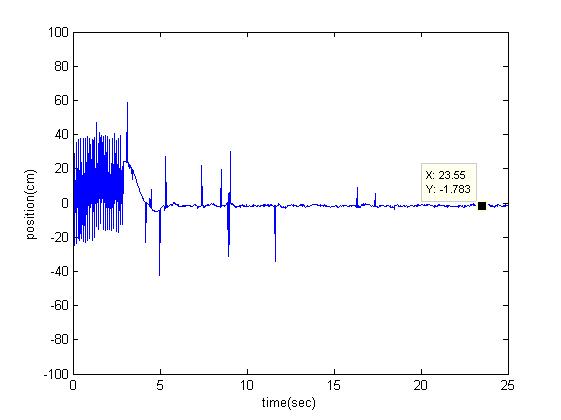
(1) Find the parameter  of the control ,with different damping ratio  and natural frequency , decay rate 

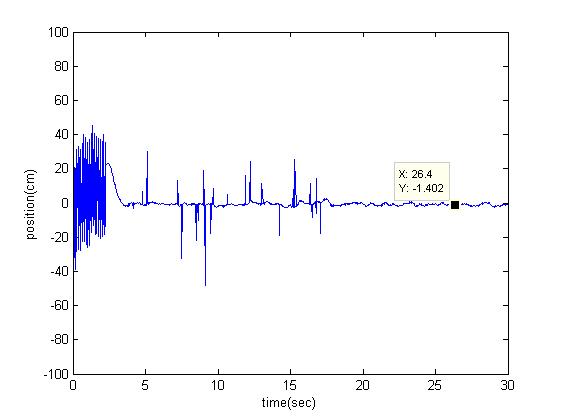
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| 1 | 3 | 10 | 0.574 | 16 | 0.44 |
| 0.707 | 3 | 10 | 0.6448 | 14.242 | 0.368 |
| 0.707 | 3 | 20 | 0.7577 | 24.242 | 0.395 |
| 0.5 | 3 | 20 | 0.7986 | 23 | 0.306 |

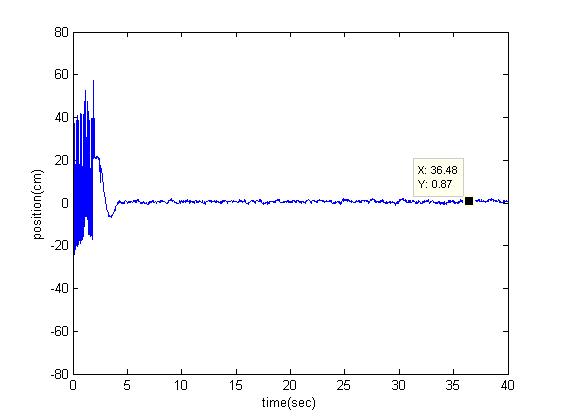


(2) Desired position is 0 cm. Set up all the parameter and plot the performance data.



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**Discussion**

* 1. Why we use a Cam to drive the beam to change angle but not use motor to drive the beam to change the angle ?

**Ans：** 因為使用凸輪可使平衡桿的轉動角度限制在一定的範圍內。

* 1. Explain when we were at beam angle experiment, why not we can make  only with ?

**Ans：** 因為本實驗伴隨著各種誤差，而使用 無法直接改善穩態響應，所以只要系統有微量的變化，都無法讓穩態誤差恆為零。

* 1. Explain when we were at beam angle experiment, what reason cause the different phenomena with different ?

**Ans：** 是比例控制參數，可以發現增加此參數有助於系統接近到平衡點，但從圖中也可以發現太大的 會使得系統不斷的振盪，反而造成系統不穩定。

* 1. Do you think this system is a stable system? What is your reason?

**Ans：** 系統的穩定性會根據不同的控制參數而有不同的結果，因此設計出好的控制參數，輸出的響應也會比較好，但實驗上會因為導線的鬆緊、球的形狀或有無生鏽，而影響實驗的控制結果。