Θ

Φ

L1

L2

L3

M1

M2

For stability to be maintained, the center of mass must be directly above the Y-axis:

$$R\_{x}=0=\frac{\sum\_{}^{}M\* R\_{x}}{\sum\_{}^{}M}=\frac{M\_{2}L\_{3}sinΘ-M\_{1}L\_{1}sinΦ}{M\_{2}+M\_{1}}$$

This implies:

$$M\_{1}L\_{1}sinΘ=M\_{2}L\_{2}sinΦ$$

Using small angle approximation:

$$M\_{1}L\_{1}Θ=M\_{2}L\_{3}Φ$$

$$Θ=\frac{M\_{1}}{M\_{2}}\*\frac{L\_{1}}{L\_{3}}\*Φ$$

For L3 (assuming L1=L2):

$$L\_{3}^{2}=2L\_{1}^{2}-4L\_{1}\cos(\left(Θ+Φ\right))$$

Using small angle approximation:

$$L\_{3}^{2}=2L\_{1}^{2}-4L\_{1}\left[1-\frac{\left(Θ^{2}+2\*Θ\*Φ+Φ^{2}\right)}{2}\right]$$

Everything but Θ and L3 are known in these equations. The idea is that we will be able to measure Φ and be able to calculate a Θ such that the horizontal component of M2L3 will cancel with the horizontal component of M1L1.