计算过程
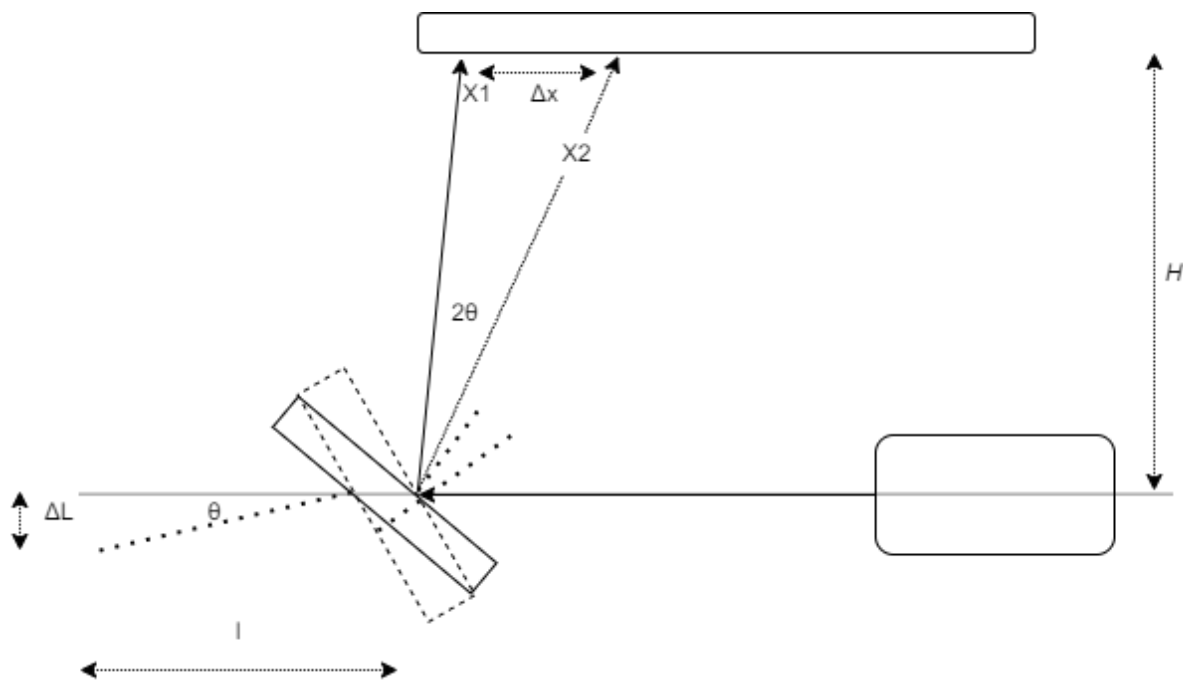
赵方程 42024137 物联201

计算公式

根据胡克定律

$$F/A = E\frac{\Delta L}{L} \text{以及} F = mg$$

$$\Rightarrow E = \frac{4mgL}{\pi d^2 \Delta L}$$

$$l \gg \Delta L, Ox_2 \approx H, \Delta L \approx l \cdot \theta, \Delta x \approx H \cdot 2\theta$$

$$\Rightarrow \Delta x = \frac{2H}{l} \cdot \Delta L$$

$$\Rightarrow E = \frac{8mgLH}{\pi d^2 l} \cdot \frac{1}{\Delta x}$$

$$U_{m仪} = 0.005kg$$
$$U_H = 2mm$$
$$U_L = 2mm$$
$$U_l = 0.1mm$$
$$\Delta_{d仪} = 0.004mm$$
$$\Delta_{x仪} = 2mm$$

n	1	2	3	4	5	6
千分尺未读数 di	0.582	0.590	0.589	0.590	0.591	0.590
d(mm)	0.633	0.641	0.640	0.641	0.₀642	0.641

序号i	1	2	3	4	5	6	7	8	9	10
拉力视值mi (kg)	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
加力过程标尺刻度xi (mm)	8.0	9.8	12.0	14.1	16.1	19.0	21.0	23.1	25.0	27.2
减力过程标尺刻度xi (mm)	8.0	10.2	12.4	14.5	15.9	19.0	21.0	23.2	25.0	27.2
平均值xi (mm)	8.0	10.0	12.2	14.3	16.0	19.0	21.0	23.15	25.0	27.2

i	1	2	3	4	5
$\Delta x_i = |x_i - x_{i+5}|$ (mm)	11.0	11.2	11.1	10.9	11.1

代入数据得

$$\overline{\Delta x_i} \pm U_{\Delta x} = 11.06 \pm 0.11 mm$$
$$L \pm U_L = 735.5 \pm 0.5 mm$$
$$H \pm U_H = 698.1 \pm 0.5 mm$$
$$l \pm U_l = 35.10 \pm 0.02 mm$$
$$d \pm U_d = 0.640 \pm 0.005 mm$$
$$\Delta mg = 0.5 * 9.8 N$$

代入 公式计算 得

$$E = \frac{8mgLH}{\pi d^2 l} \cdot \frac{1}{\Delta x} = 0.406 * 10^{11} N \cdot /m^2$$

根据误差传递公式 计算得

$$U_E = \sqrt{\frac{\delta F}{\delta x}^2 U_x^2 + \dots} = 0.403 \pm 0.006 * 10^{11} N \cdot /m^2$$

```cpp
#include <cmath>
#include <iostream>

using namespace std;

int main() {
    const double xi = 11.06 * 1e-3;
    const double Ux = 0.11 * 1e-3;
    const double L = 736 * 1e-3;
    const double UL = 2 * 1e-3;
    const double H = 698 * 1e-3;
    const double UH = 2 * 1e-3;
    const double l = 35.1 * 1e-3;
    const double Ul = 0.1 * 1e-3;
    const double d = 0.640 * 1e-3;
    const double Ud = 0.005 * 1e-3;
    const double m = 0.5;
    const double Um = 0.005;
    const double g = 9.8;
    const double pi = 3.14159265358979323846;
    const double E = 8 * m * g * L * H / (pow(d, 2) * l * pi * xi);
    const double UE = sqrt(
        pow((8 * g * L * H / (pi * pow(d, 2) * l * xi)) * Um, 2) +
        pow((8 * m * g * H / (pi * pow(d, 2) * l * xi)) * UL, 2) +
        pow((8 * m * g * L / (pi * pow(d, 2) * l * xi)) * UH, 2) +
        pow((16 * m * g * L, H / (pi * pow(d, 2) * pow(l, 2) * xi)) * Ul, 2) +
        pow((8 * m * g * L * H / (pi * pow(d, 2) * l * pow(xi, 2))) * Ux, 2));
    cout << E << " " << UE << endl;
    return 0;
}
```