Numerical Calculus II homework

José Ángel de Bustos Pérez

2 de enero de 2017

Resumen

Use the Broyden and Newton methods to solve the following.

In calculating the shape of a gravity-flow discarge chute that will minimize transit time of discharged granular particles C. Chiarella, W. Charlton and A.W. Roberts solve the following equations by Newton's method:

$$f_n(\theta_1, \ldots, \theta_N) = \frac{\sin\theta_{n+1}}{\upsilon_{n+1}} \cdot (1 - \mu \cdot \omega_{n+1}) - \frac{\theta_n}{\upsilon_n} \cdot (1 - \mu \cdot \omega_n) = 0 \quad (1)$$

$$f_N(\theta_1, \ldots, \theta_N) = \Delta y \cdot \sum_{i=1}^{N} \tan\theta_i - X = 0 \quad (2)$$

Where:

$$\upsilon_n^2 = \upsilon_0^2 + 2 \cdot g \cdot n \cdot \Delta y - 2 \cdot \mu \cdot \Delta y \cdot \sum_{j=1}^{n} \frac{1}{\cos\theta_j}$$

$$\omega_n = -\Delta y \cdot \upsilon_n \cdot \sum_{i=1}^{N} \frac{1}{\upsilon_i^3 \cdot \cos\theta_i}$$

for each $n = 1, \ldots, N$.

The constant υ_0 is the initial velocity of the granular material, X is de x-coordinate of the end the chute, μ is the friction force, N is the number of segments and $g = 32{,}2\ ft/s^2$ is the gravitational constant. The variable θ_i is the angle of the i-th chute segment.

Solve (1) and (2) for:

$$\theta = (\theta_1, \ldots, \theta_N)^t \quad (3)$$
$$\mu = 0 \quad (4)$$
$$X = 2 \quad (5)$$
$$\Delta y = 0{,}2 \quad (6)$$
$$N = 20 \quad (7)$$
$$v_0 = 0 \quad (8)$$

Solution will be considered a valid one when:

$$||\theta^{k)} - \theta^{k-1)}||_\infty < 10^{-2}$$