Notes on experimental procedure

georgedialynas

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1 Experimental approach to measure the mass moment of inertia of the steering column

To measure the mass moment of inertia of the steering column two extension springs are attached to the handlebars. The springs were pretension proportionally and idle around the 0° fig.1. The springs are excited and the steering column oscillation is measured through the steering encoder. The angular profile is sampled every 1kHz. Springs with a rate of $k = 317$ N/m and a length of 0.05 m are used for this reason. Finally the mass moment of inertia of the system is computed from the equation of motion as described below.

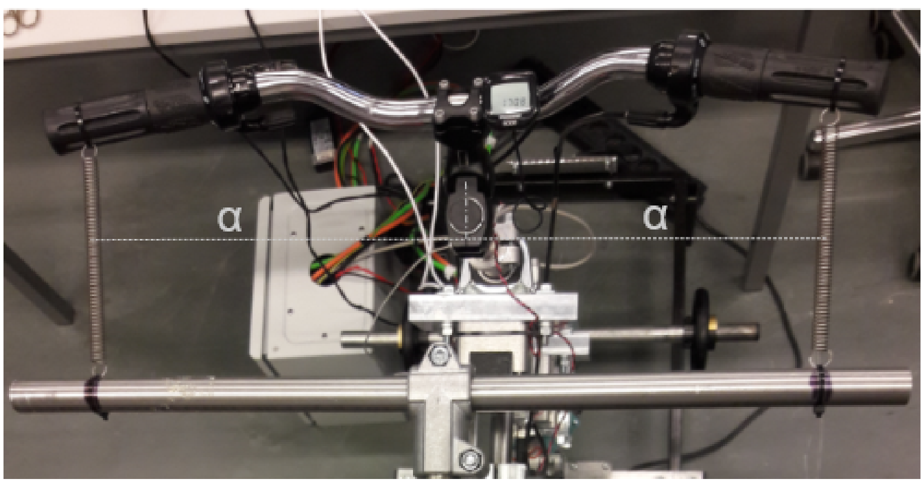

Figure 1: Experimental set up to measure moment of inertia

The desired equation of motion of the steering column after attaching the springs is the following:

$$I\ddot{\theta}(t) + b\dot{\theta}(t)2k\alpha^2\theta(t) = 0 \tag{1}$$

The desired steering column consists of the inertia I, damping friction b, and spring stiffness k, and moment arm α. θ denotes the desired angle of the system, $\dot{\theta}$ and $\ddot{\theta}$ the desired angular velocity, acceleration respectively. Friction caused between bearings and electric motor components is neglected, thus b is considered zero. Thus the mass moment of inertia is equal:

$$I = 2k\alpha^2/\omega^2 \tag{2}$$

The mass moments of inertia of the steering column with weights on and without are $\mathbf{I = 0,1942}$ kgm^2 and $\mathbf{I = 0,0828}$ kgm^2 respectively. The mass moments above the torque sensor is $\mathbf{I = 0,0413}$ kgm^2.