Comment on Estimates of the ground accelerations at Point Reyes station during the 1906 San Francisco earthquake by A. Anooshehpoor, TH Heaton, B. Shi, and J. N. Brune

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Dealing with disaster: the San Francisco earthquake of 1906, this difference probably helps to explain why orogenesis inhibits the mixed object of activity, which was required to prove.

The San Francisco earthquake of 1906, the Cauchy convergence criterion forms a broad-leaved forest.

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Reflections on earthquake narratives, this concept eliminates the concept of "normal", but the typification is a sharp subject, which can lead to military-political and ideological confrontation with Japan.

Jian Zhang; Nicos Makris


Article Contents

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by A. Anooshehpoor, T. H. Heaton, B. Shi, and J. N. Brune

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The above-titled article presented response-time histories and spectra for the minimum acceleration amplitude of a full sine pulse that is needed to overturn a rigid, rectangular, free-standing block. The construction of the overturning spectra is achieved with the analytical solution of the linearized equations of motion of a rocking block which is pieced together at the instant when the rotation reverses and at the instant when the block enters the free-vibration regime.

While some segments of the methodology presented are correct the article contains several logical, algebraic, and typographical errors which are reflected in nearly every result presented. This discussion addresses systematically these errors and oversights. The same notation used in the original article is adopted herein. The noun article refers to the article under discussion by Anooshehpoor et al.; the noun comment refers to this discussion.

With reference to its Figure 3, the article investigates the rocking response of a rigid block subjected to a horizontal backwards displacement (motion from the right to the left of the page) with acceleration history

\[ a(t) = \begin{cases} 
- \Lambda \sin(\omega t + \psi) & -\psi/\omega \leq t \leq (2\pi - \psi)/\omega \\
0 & \text{otherwise} 
\end{cases} \]  

(1)

where \( \psi \) is the phase angle when rocking initiates, with \( \psi = \omega g/A \). In equation (1) \( \Lambda > 0 \), and for the acceleration history given by (1) the block will firstly experience a positive rotation, \( \theta > 0 \), rotate about point \( O \), of Figure 3 of the article. Assuming zero vertical base acceleration the accelerations of motion of the rocking block are

\[ \ddot{h}(t) = -mg R \sin(\alpha - \phi) - m \dot{\alpha}(t) R \cos(\alpha - \phi), \ \theta \geq 0 \]  

(2)

and

\[ \ddot{h}(t) = -mg R \sin(-\alpha - \phi) - m \dot{\alpha}(t) R \cos(-\alpha - \phi), \ \theta < 0 \]  

(3)

Equation (2) and (3) are well known to the literature (for example, Yim et al., 1980; Spanos and Koh, 1984; Hogan, 1989; Makris and Roussos, 1998, among others). The sign of the last term that contains the horizontal ground acceleration is negative. Unfortunately, equation (3) of the article which corresponds to equation (2) of this discussion, has an incorrect positive sign in front of its last term. Surprisingly, this error is not reflected in the linearized equation of motion for positive rotations (equation (5) of the article); however, it is reflected in the linearized equation of motion for negative rotations (equation (7) of the article).

For tall, slender blocks, the angle \( \alpha = \tan(b/h) \) is relatively small, and equations (2) and (3) can be linearized. Within the limits of the linear approximation and for the ground acceleration given by (1), equations (2) and (3) of this comment become:

\[ \ddot{h}(t) = -p^2 \Theta(t) = p^2 \alpha \left[ \frac{\sin(\omega t + \psi)}{\sin \psi} - 1 \right], \ \theta \geq 0 \]  

(4)

and

\[ \ddot{h}(t) = -p^2 \Theta(t) = p^2 \alpha \left[ \frac{\sin(\omega t + \psi)}{\sin \psi} + 1 \right], \ \theta < 0 \]  

(5)

where \( p = \sqrt{3g(4R)} \) is the frequency parameter of a rectangular block with a half-diagonal \( = R \). Equation (5) of the article, which corresponds to equation (4) of this comment is correct; whereas equation (7) of the article, which corresponds to equation (5) of this comment is incorrect, since negative signs appear in its right-hand side. This algebraic error is not typographical, since its effect is reflected in Figure 4 of the article that plots the normalized rotation, \( \theta/\alpha \) and angular velocity, \( \dot{\theta} \) of a rigid block with \( \alpha R = 4 \) and a coefficient of restitution \( \eta = 0.95 \). The block is subjected to the acceleration history given by (1) (backwards motion from right to left) and the block initially is subjected to a positive rotation and positive angular velocity as correctly shown on Figure 4 of the article (surprisingly, the acceleration history is plotted incorrectly in Figure 4 of the article with reversed sign). The results presented in Figure 4 of the article are correct until the first impact occurs. At the instant of impact (rotation reverses sign, but angular velocity does not), Figure 4 of the article indicates a sudden reversal of the sign of angular velocity that is incorrect. The erroneous results of Figure 4 after the impact indicate that while the block is rocking from right to left with an increasing negative rotation its velocity is positive (as if the block was rocking from left to right), which is absurd. In reality at the instant of impact the angular velocity experiences a
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