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Title: Hydrodynamics of pedestrians' instability in floodwaters
Hydrology and Earth System Sciences

General Comment:

People safety can be compromised when they are exposed to floodwaters that exceed their ability to remain standing, thus leading to a great loss of casualties. Therefore, it is important to study the pedestrian's instability in floodwaters. In order to overcome the scatter of existing experimental data, the authors introduced a dimensionless mobility parameter θ_P which accounts for both flood and human characteristics. In addiction, a simplified 3D numerical model describing a detailed human geometry partly immersed in water was built to reproduce a selection of the existing experimental data, which is the first example of numerical investigation on the instability conditions of people in floodwater. In general, the topic of this article is appropriate for this journal, and it should be of interest to researchers in the contexts of flood risk analysis and management. However, there exist some obvious errors in the derivation of the dimensionless coefficients θ_P, and the current version can not be accepted, but encourage the authors to re-submit the revised version with major revision.

Specific Comments:

(1) The lift force (***Li***) should not be included in the force analysis.
Lift force is generated by pressure difference which results from the flow velocity difference of a completely submerged object. That is to say, the flow velocity at the upper surface of the submerged object is greater than that at the lower surface, so the top pressure is lower than the bottom one (Chien and Wan, 1999). A human body is not completely submerged in floodwaters, and additionally there is little flow water between the bottom surface and the human feet. Therefore it is not necessary to account for the lift force.
Chien N and Wan ZH (1999). Mechanics of sediment transport. ASCE Press, Reston VA.

(2) Such an assumption of $\rho_p = \rho$ is problematic in this derivation.
[The average density of the human body (ρ_p=1062 kg/m^3) is generally assumed equal to the density of muddy water, thus ρ_p is substituted with ρ in Eq. (2).]
The expression of $\rho_p = \rho$ indicates a human body in floodwater can float, instead of sliding or toppling instability. Therefore it is not appropriate to substitute ρ_p with ρ in Eqs. (6) and (13).

(3) The Drag and lift forces are related to the wetted area rather than the total area of the human body. Therefore in the Eqs. (4) and (5), the wetted area projected to the incoming flow should be equal to $\boldsymbol{H\,l}$ rather than ($\boldsymbol{H_p\,l}$). Although the wetted water depth does not coincide with the undisturbed water depth $\boldsymbol{H}$, this slight difference can be neglected. So all the following derivation processes are incorrect.
Please see the correct derivation presented as follows:
Sliding:
The sliding instability condition is

$$D > (W - B) \cdot \mu \qquad (1)$$

Drag force is a function of the square of flow velocity U and the wetted area $H\,l$.

$$D = \frac{1}{2} \cdot \rho \cdot U^2 \cdot C_D \cdot H \cdot l \qquad (4)$$

$$\frac{1}{2} \cdot \rho \cdot U^2 \cdot C_D \cdot H \cdot l = [\rho_p \cdot g \cdot (H_p \cdot d \cdot l) - \rho \cdot g \cdot (H \cdot d \cdot l)] \cdot \mu \qquad (6)$$

$$\frac{U^2 C_D}{\mu g} = \frac{2d(H_p \rho_p - H\rho)}{H\rho} \tag{8}$$

Toppling

The toppling instability condition is

$$(W - B)\cdot d = D \cdot \frac{H}{2} \tag{12}$$

$$[(\rho_p \cdot g \cdot l \cdot H_p \cdot d) - (\rho \cdot g \cdot l \cdot H \cdot d)]\cdot d = (\frac{1}{2}\cdot \rho \cdot U^2 \cdot C_D \cdot H \cdot l)\cdot \frac{H}{2} \tag{13}$$

$$gd^2 (H_p - H) = \frac{1}{4} U^2 H^2 \tag{14}$$

(4) The dimensionless mobility parameter θ_P indicates that the stability degree of a human body in floodwater is only related to the body height and the flow condition. However, all the previous studies show that the stability degree of a human body is related to both body height and body mass (Abt et al., 1989; Jonkman et al., 2008; Xia et al., 2014; and so on). The difference is attributed by the neglect of the difference between ρ_P and ρ.