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Interactive comment on "A study on the derivation of a mean velocity formula from Chiu's velocity formula and bottom shear stress" *by* T. H. Choo et al.

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The paper proposes a "new" formula for the estimation of the mean flow velocity, u, derived from some insights of a probabilistic and entropy-based approach developed by Chiu, who identified a velocity distribution model for open channels flow. The formula is based on hydraulic and geometric characteristics of the river site and on the entropy parameter, M.

General Comments

I have serious concerns about this work and, in particular on the theoretical aspects

and on the applicability of the proposed procedure.

However, before to get into the heart of the matter, I would like to underline what is the benefit of the Chiu's velocity model in the framework of streamflow measurements. One of the main matters involving the flow monitoring in natural channels is the difficulty to carry out velocity measurements for high stages that are, however, fundamental to achieve a reliable rating curve at a gauged river site. This problem is due to the real difficulty to sample velocity points in the lower portion of flow area, also for dangers that operators might face during the measurement itself. On the other hand, the maximum flow velocity, umax, can be easily sampled also for high stages because its location occurs in the upper portion of the flow area (Fulton and Ostrowsky, 2008; Moramarco et al. 2004). It is worth of noting that umax from a point of view of the deterministic hydraulic didn't appear thus useful in the past. Thanks to also to Chiu's works its importance was brought out by proving that the velocity distribution in a channel cross-section can be assessed as a function of umax and of the curvilinear coordinates in the physical space (Chiu; 1988, 1989).

The above concepts summarize briefly the theoretical background of Chiu's approach that the authors attempted to describe in the manuscript from page 6422 to 6427. Indeed, all equations from 1 to 22 can be found in Chiu's papers (1987, 1988, 1991, to cite a few). Even eq.(21), that should be the "new" formula proposed by the authors, along with the procedure to get it, can be found in Chiu (1991), [see pag.622, eq.33]. Indeed, eq.(33) in Chiu (1991) reads:

u=[(ξ_max-ξo)ho u*ˆ2)]/(kin_visc F(M))

knowing that for the curvilinear coordinates ξ_max=1 and ξo=0, and that the shear velocity, u*=sqrt(gRIf), one obtains eq.(21); (for other symbols see manuscript)

So, I regret to say there is no new ground in this work, considering that the same stuff (Fig.1 included) was published by Chiu twenty years before. Nonetheless, about the theoretical aspects proposed by the authors I would like to clarify some insights.

The first, in the Conclusions I read, “the new velocity formula. . ..can estimate accurately the maximum velocity that is hardly measurable in natural rivers”. I disagree about this statement. I hope there is a mistake in the phrase. Likely, authors meant “the mean flow velocity” in place of “the maximum velocity”. If, on the contrary, they really wanted to say “the maximum velocity” then the sentence would be fully wrong. Indeed, as I have pointed out above, during high floods the quantity that can be easily sampled is just umax. To be correct, the real value of umax is unknown, but the maximum value of sampled velocity points in the upper portion of flow area can be assumed for it. Recently, several works (Moramarco et al., 2011, Fulton and Ostrowsky, 2008) based on the Chiu’s approach, showed that it’s possible to estimate u by sampling umax. Nowadays, no-contact radar sensors can be used to this end (Fulton and Ostrowsky, 2008) and new projects on the monitoring, also by satellite, of the maximum surface flow velocity, through which umax can be assessed, are developing. Based on the above insights, I guess that the authors can understand my serious concern on their procedure shown in Table 1 wherein, at the first step, the measured values of u (authors missed to write u-see Section3) are necessary for estimating F(M). My point is that umax can be easily assessed by using the same velocity points through which the “measure” of u has been obtained. Therefore, Φ(M) in eq.(12), can be easily estimated on the basis of observed pairs (u, umax) belonging to velocity measurements sample, available at the gauged river site. In other words, since for each velocity measurement u and umax are given, as a consequence the procedure for estimating F(M), detailed in Section 3, is useless.

The second aspect regards the applicability of eq.(21). This formula is based on the knowledge of the energy slope, "If", and hξ during the measurement and/or, if I well understood the final purpose of authors, during a flood. Besides the fact that the authors don’t give any information how to estimate them, however I have to say that both quantities are not easy to assess. In particular, if I well understood, the authors assume the river bottom slope in place of "If". Since the geometric and hydraulic characteristics of investigated channels are not given, I don’t know if laboratory and field data used for

the analysis refer to uniform flows and/or channels having, for their geometry, a kinematic behaviour in terms of flood routing. However, even if this was the case, the reality of natural channels would be quite different, considering that "If" might be strongly affected by unsteady flows, making it totally different from the bottom channel slope. Also for hξ, no information on its assessment is given. For wide channels, I guess hξ can be assumed as the flow depth, by making its assessment quite simple. However, for the non-wide channels as shown in Chiu’s works, hξ depends on a certain number of parameters of not simple assessment, thus increasing the uncertainty. Therefore, my question is what is the benefit of using eq.(21) when one can apply, for instance, the Manning’s formula for assessing u and, hence, the discharge? Eq.(21) has the same limitations of Manning’s formula, seeing that the energy slope is approximated by the river bottom slope (kinematic approximation). In Chiu (1991), the authors can find an interesting comparison with the Manning’s formula. Therefore, if I well understood what the "new discharge estimation method" is, i.e., to turn recorded stages into mean flow velocity through eq.(21), and then into discharge, I have to say that the method is not "new" at all; it is a simple kinematic approach wherein a parameter, M, is assessed on the basis of velocity measurements carried out at a gauged river site. Finally, about the good performance of the proposed method, I expected it considering that the authors use the “observed” mean flow velocity to assess F(M).

Specific Comments

The introduction should be rewritten. I didn’t understand what the design flood estimation has to do with the mean flow velocity formula. The introduction should underline the issues concerning the measure of the mean flow velocity in natural channels. The design flood is a matter of floods frequency and it is a question quite different from the aim of the paper.

In Section 2.4- third line from the bottom of section “. . .if there are measured values of F(M),. . .If”. How do you measure "If" at a gauged river site? You need at least two concurrent stages recorded at two river sites not too faraway.

As far as the results are concerned, I have to say that the application is not clear at all. As above pointed out no information were provided by the authors in terms of laboratory and field data. I understand that all information can be found in the cited papers, but the reader need to know, at least through synthetic tables, the main geometric and hydraulic characteristics of channels, so that he/she can have an idea about the data used for the analysis.

The English should be improved. Several mistakes are present in the manuscript.

Conclusions

Based on the above comments, I regretfully have to reject the paper. I hope that this review can help the authors to address their future works on this topic.

Additional References

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