Discussion to "Experimental and numerical modeling of symmetrical four-branch supercritical cross junction flow"

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The Discussers congratulate the Authors for their work and would like to raise some questions and comments about their results and statements. The paper compares the computed with the measured flow depths and discharges for five flow configurations. The authors found discrepancies concerning the prediction of the location and the thickness of the oblique jumps mainly because these are set on one cell in the numerical model.

The Discussers argue that the prediction of the discharge distribution at the junction through a "quality indicator" as suggested by the authors, namely E_{QT} in 4.2, p. 728, is somewhat misleading. The authors compared the difference between the computed and measured outflows in the x direction to the total inflow discharge, whereas they should have used the measured outflow in the x direction as E_{QT}

$$E_{\mathrm{QT}} = \left(\frac{Q_{\mathrm{sxC}} - Q_{\mathrm{sxM}}}{Q_{\mathrm{sxM}}} \right) \qquad \text{(D1)}$$

It is easy to realize that E_{QT} used by the authors gives smaller errors compared to those obtained with Eq. (D1).

The authors state in 4.2.1 that the numerical model overestimates the discharge distribution for Type II regime by about $\Delta E_{QT} = 1\%$, whereas in Fig. 7 E_{QT} for Type II regime 2 has values as high as 12%, and for Type II regime 1 as high as 2%. The Discussers would like to ask the Authors: Why for flow pattern Type II regime 3 there is a balance of over- and underestimations for a slope of 5%, more under- than overestimations for a slope of 3% and less under- than overestimations for a slope of 1%. This behaviour seems intriguing, considering that all cases belong to the same flow pattern.

In the Discussers' opinion the way of estimating the average flow depth error $\overline{dh}$ in 4.3 is again somewhat misleading, because it does not take into account the actual magnitude of *dh*, but rather the arithmetic difference between the computed and measured flow depths, possibly resulting in a cancellation of positive and negative *dh*s. It appears that a more appropriate way to measure the average error is

$$\overline{dh} = \frac{\sum |dh|}{n_b} \quad \text{(D2)}$$

In Table 11, an average error for the flow depth of up to 5.73 mm is reported. This large error would be even larger if the average error were computed using Eq. (D2). The same applies to the average error in the discharge distribution, with errors of up to 3%. The Discussers encourage the Authors to discuss the results using the expressions for *dh* and

E_{QT} suggested above. In addition, it seems that a more appropriate way for estimating average errors would be to consider only the cases with identical flow patterns.

With regard to the measured flow depths used to compare with the numerical results, it appears that the choice made in case C3, namely Type III flow pattern, was not the most appropriate (Fig. 11), because in the computed flow field one jump is formed right at the junction entrance and not inside the junction as is assumed in the definition of Type III flow pattern (Section 3.2). In the Discussers' opinion the computed case C3 would correspond to a Type II flow pattern (Section 3.2, Nanía et al. 2004) because a jump right at the entrance (or if an important portion of it is in the channel) is not considered inside the junction. This may explain the large error of Case C3 in Table 11. Hence, the statement "the model can predict the observed flow pattern for all configurations" is not rigorously exact, at least for the Type III flow pattern.

The Discussers would also like to emphasize the small size of the experimental setup used by the Authors, which resulted in flow depths of only few millimetres in the supercritical flow regime. Then, large errors associated with scale effects and with the measurement of flow depths may occur. The latter, particularly in supercritical flows, may cause large errors in velocities and Froude numbers. The accuracy of the flow surface level measurement reported by the Authors is ±0.5 mm. It appears that this accuracy is too optimistic with regard to the high instability of the water surface for Froude numbers in excess of 3. If the accuracy would be ±1 mm rather than ±0.5 mm the relative error in the flow depths would vary from ±9% to ±23% (with depths reported in Table 3 ranging from 4.4 mm to 11.5 mm), resulting therefore in large errors. The Discussers again would like to have the Authors' comments on this observation.

References

Nanía, L.S., Gómez, M., Dolz, J. (2004) Experimental study of the dividing flow in steep street crossings. *J. Hydr. Res*. 42(4), 406-412.