Discussion of "Clear-Water Local Scour around Pile Groups in Shallow-Water Flow" by Ata Amini, Bruce W. Melville, Thamer M. Ali, and Abdul H. Ghazali

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The authors reported experimental results of scour measurements around pile groups with varying pile spacing and arrangements. The authors also conducted some experiments on submerged pile groups and pile groups of nonuniform spacing. However, no analysis has been included in the paper on the effect of nonuniform pile spacing. They suggested Eq. (4) for estimation of scour depth at pile groups. In the equation $K_h = 1$ for unsubmerged pile groups, K_{Smn} could be obtained from Eq. (3), and Y_{Seq} is the local scour depth at a single, unsubmerged cylindrical pier of diameter equal to nD, which should be estimated by using existing empirical methods presented for single piers. However, it is not explained by the authors which existing method (e.g., the HEC-18 procedure or the New Zealand pier scour equation) the correction factor K_{Smn} should be applied to.

The discussers aim to complement the authors' analysis by using some new independent data and some existing data that were not considered by the authors. For discussion on Fig. 6(a), the observed scour depths (y_s) in the authors' experiments were compared with the estimated scour depths using two methods presented by the authors and Ataie-Ashtiani and Beheshti (2006) in Fig. 1 of this discussion. The method of normalization in Fig. 6 of the paper for design scour depth by different values of

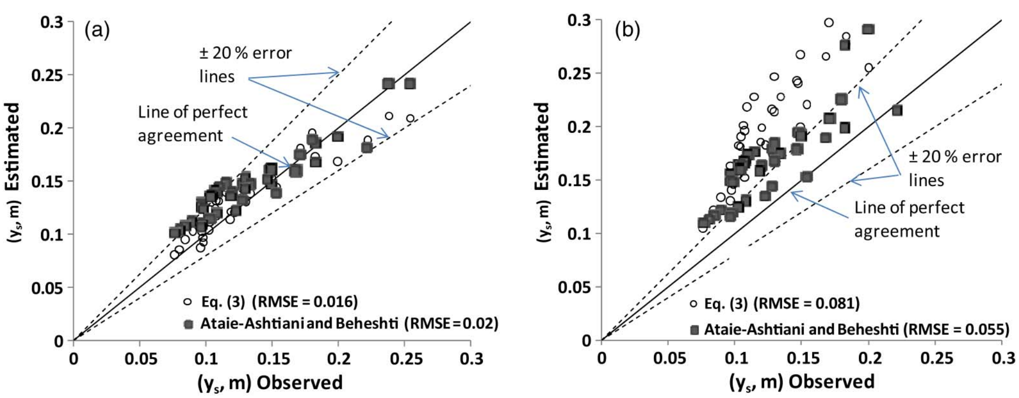

Fig. 1. Comparison of observed and predicted scour depths; Y_{Seq} calculated based on (a) HEC-18 procedure; (b) New Zealand pier scour equation

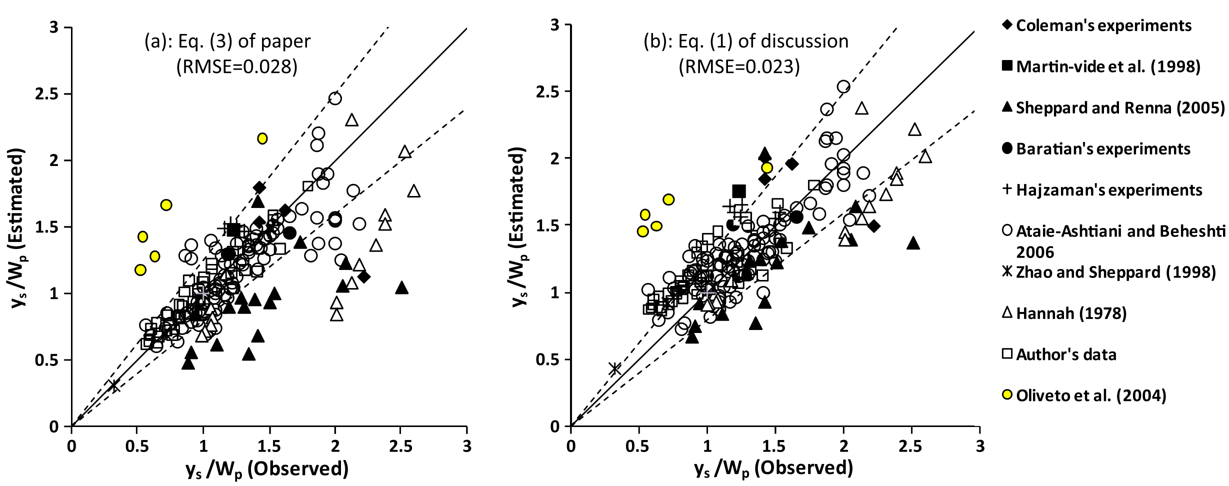

Fig. 2. Comparison of observed and predicted scour depths; Y_{Seq} is calculated based on HEC-18 procedure

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Table 1. Details of Baratian and Hajzaman's Experiments Used in Fig. 2

Data	Run	d_{50} (mm)	y (m)	U/Uc	D (m)	S_n (m)	S_m (m)	m	n	y_s (m)
Baratian's (2007) experiments	1	0.6	0.140	0.78	0.016	0.048	0.065	3	2	0.038
	2	0.6	0.144	0.764	0.016	0.032	0.04	3	2	0.048
	3	0.6	0.142	0.773	0.016	0.032	0.04	3	2	0.053
Hajzaman's (2008) experiments	1	0.6	0.127	0.739	0.0221	0.03	0.045	3	2	0.0581
	2	0.6	0.130	0.730	0.0221	0.03	0.045	3	2	0.066
	3	0.6	0.143	0.723	0.0158	0.03	0.045	3	2	0.0393
	4	0.6	0.143	0.719	0.0158	0.03	0.045	3	2	0.0474
	5	0.6	0.145	0.728	0.0158	0.03	0.036	4	2	0.0394
	6	0.6	0.139	0.730	0.0158	0.03	0.036	4	2	0.0367
	7	0.6	0.142	0.740	0.0216	0.03	0.036	4	2	0.0661
	8	0.6	0.139	0.748	0.0216	0.03	0.036	4	2	0.0519

Y_{seq} on the abscissa and ordinate is inconsistent and confusing, because the authors normalized the measured scour depth around a pile group (y_s on the abscissa) by Y_{seq} measured around the same pile group with zero pile spacing, whereas they normalized the calculated scour depth (y_s on the ordinate) by estimated Y_{seq} using existing empirical equations for a pier of diameter nD. Fig. 1 is replotted from Fig. 6(a) of the paper without normalization. Fig. 1(a) is based on the HEC-18 method of computation of Y_{seq}, whereas in Fig. 1(b), the New Zealand pier scour equation (Melville 1997) was used for calculating scour depth around a pier of diameter nD with correction factor K_{Smn} for pile groups. The root mean square errors (RMSE) for the two methods are also presented in Fig. 1.

Fig. 2 of this discussion compares the measured and estimated scour depths normalized by $W_p = \text{nD}$ for different laboratory data using the HEC-18 method of computation of Y_{seq} and K_{Smn} obtained from both Eq. (3) of the paper and Eq. (1) of this discussion as

$$K_{\text{smn}} = 0.7[m^{0.38}n^{-0.95}(S/D)^{-0.387}] + 0.42 \qquad (1)$$

In Fig. 2, data for Coleman's experiments are reported by Sheppard and Renna (2005). Data for the Baratian (2007) and Hajzaman (2008) experiments are listed in Table 1. These experiments were performed in a laboratory flume, the details of which can be found in Ataie-Ashtiani et al. (2010). One data set reported by Martin-Vide et al. (1998), five data sets reported by Oliveto et al. (2004), two data set reported by Zhao and Sheppard (1998), and data from Hannah (1978) were also used for comparison.

The comparison of scour depths predicted by different methods with the experimental observations of the authors and other existing data and reported data in this discussion indicate that the advantages of using one method over another are minor.

Acknowledgments

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The writers would like to thank the discussers for the useful discussion of the article. The new data by Baratian (2007) and Hajzaman (2008) are a useful addition to existing data. Fig. 3(b) shows the data obtained for nonuniform pile groups and compares the normalized scour depths for uniform and nonuniform pile spacing. The impact of nonuniform spacing (S_m and S_n) is discussed on page 179 of the paper.

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The discussers appear to have misunderstood the approach used to normalize scour depths in Fig. 6. The scour depth at a single unsubmerged cylindrical pier of diameter equal to $nD(Y_{\mathrm{Seq}})$ was measured from experiments. This measured value of Y_{Seq} was used to normalize the measured and estimated data presented in the paper, in a consistent and rational approach.

The discussers have used existing data, complemented by the new data by Baratian and Hajzaman, to derive an alternative equation to Eq. (3) for estimating K_{Smn}. Their equation appears to give a better collapse of the data, as shown in Fig. 2 of the discussion. The authors' equation for K_{Smn} has the advantage that it is based on real data for a simple pier and is therefore applicable to any existing scour equations.

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