Responses to the comments of Reviewer 4:

► Overall Comment

The author use UAV to obtain the point cloud data of river cross section, and propose the nonparametric estimation method to realize the fitting of river cross section. In manuscript KLR algorithm can better fit various key features of different types of river cross sections, but it cannot compare with other methods for fitting river cross-section, such as SfM, DEM, etc. I have the following suggestions and questions to further improve the current manuscript.

Response ◄

The authors appreciate this reviewer comments provided. The authors tried their best to improve the quality of the current manuscript following the provided comments from this reviewer. Hope the modifications satisfactory to this reviewer.

► Major Comment1

For this title, the nonparametric estimation method covers too much, and this article only focuses on the KLR algorithm

Response ◄

The authors appreciate this critical comment. The title was modified following this reviewer's comment as the following. Hope the modified title is acceptable to this reviewer.

KNN local linear regression for demarcating river cross-sections with point cloud data from UAV photography
URiver-X version 1.0 -methodology development

► Major Comment 2

In Introduction section, too many drone applications were introduced, but there was a lack of introduction to methods related to river cross-section fitting.

Response ◄

The authors improved the introduction section of river cross-section bathymetry and fitting as the following.

There have been some studies related with river bathymetry measures riverbed elevation generally using watercraft with multibeam sonar or remotely sensed data of digital elevation models (DEMs). The demarcation of the cross-section in a river has been mainly made with a DEM in the literature (Gichamo et al., 2012; Petikas et al., 2020a, b; Pilotti, 2016; Sanders, 2007). Tarekegn et al. (2010) employed Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) to generate 15m resolution DEM for 2D hydrodynamic flood modeling and Matgen et al. (2011) presented an automatic delineation of flooded areas with Synthetic Aperture Radar (SAR) images. Azizian and Brocca (2020) performed a comprehensive evaluation of remotely sensed DEMs for flood inundation mapping including the recently available Advanced Land Observing Satellite (ALOS) DEM. Biswal et al. (2023) suggested a Multi-DEM approach using machine learning techniques to demarcate cross-sections adopting the medium resolution DEMs such as Shuttle Radar Topography Mission (SRTM) and ASTER. Petikas et al. (2020b) proposed a novel method to automatically extract river cross-sections from a DEM along with a parametric cross-section extraction algorithm.

Most of the existing studies were focused on drawing sections with low resolution DEMs and improving accuracy. Sanders (2007) tested several on-line public domain DEMs to parametrize 2D hydrodynamic models and concluded that those DEMs contains high vertical and horizontal biases. Gichamo et al. (2012) proposed an approach that simulates river cross-sections from ASTER Global DEM and discussed that the low resolution and the inadequate vertical accuracy could be improved by preprocessing the DEM. Channel widths of small and medium-sized rivers are too small to use DEM-based methods since the resolution of available DEMs are much coarse to draw cross-sections.

Meanwhile, UAV aerial surveying has been easily available and become very economic methods to acquire 2D data. A cross-sectional algorithm for the cloud point dataset of UAV aerial surveying has not been much tested in depth especially for deriving river cross-sections, since the characteristics of the point cloud dataset are far different from the DEM in that a study area for UAV aerial surveying is commonly smaller and many more points can be acquired from UAV aerial surveying.

► Major Comment 3

page 4, line 79, 'How, the dense cloud point dataset obtained from UAV aerial survey and the SfM technology mostly contains errors', lacking relevant experiments or literature to prove the existence of errors here.

Response ◄

The authors appreciate this pinpointing comment. The sentence was modified by adding relevant references and tone down as the following.

However, the dense cloud point dataset obtained from UAV aerial surveying and the SfM technique might contain systemic errors (Carbonneau and Dietrich, 2017; Tsunetaka et al., 2020)

► Major Comment 4

line 103 of page 5, "a fixed function of the multilateral regression with a feed parameters is limited to the highly variable shape of the cross section." It expresses that Polynomial regression is not applicable to river cross section, and this method is still used in subsequent comparative experiments.

Response ◄

The authors appreciate this insightful comment and totally agree with this controversy demonstration. The sentence was made up after the authors finished the experiment. The authors considered that this sentence should be removed in this section since this has been proved from the experiment in the result section of the current study as the following.

With the point cloud data obtained from UAV aerial surveying and postprocessing, the river cross-section must be demarcated. A nonparametric regression approach is adopted in the current study, especially K-nearest neighbor local regression (KLR) compared with the parametric polynomial regression method.

► Major Comment 5

page 8, line 165 introduces the improvement of KLR algorithm on KNN algorithm. It is recommended to include KNN algorithm in comparative experiments to ensure the effectiveness of this improvement.

Response ◄

The authors appreciate this valuable comment. The KNN mode was tested to the trapezoid channel and presented in section 3.2 and Figure 5 as the following. Hope this addition is satisfactory to this reviewer.

Additionally, different KNN models were tested and compared with the KLR model since the KLR algorithm was improved from the KNN algorithm. The result of the KNN is presented in Figure

5(a) and indicates that the demarcated surface from the KNN model is rather rough since the model randomly selects one among k-closet neighbors with the weight probability in Eq.오류! 참조 원본을 찾을 수 없습니다.. Because no smoothing process is present in the KNN model in Figure 5(a), the demarcated cross-section from this model is coarser than the one of the KLR model shown in Figure 5(c). Furthermore, the KNN1 model selects the closest neighbor of the measured values for the channel demarcation and coarse cross-section was made as shown in Figure 5(b) similar to the one of the KNN model in Figure 5(a). Note that this KNN1 model provides the result when no smoothing process is applied. The cross-section without any smoothing process will be drawn by connecting the closet points of the observed cloud point.

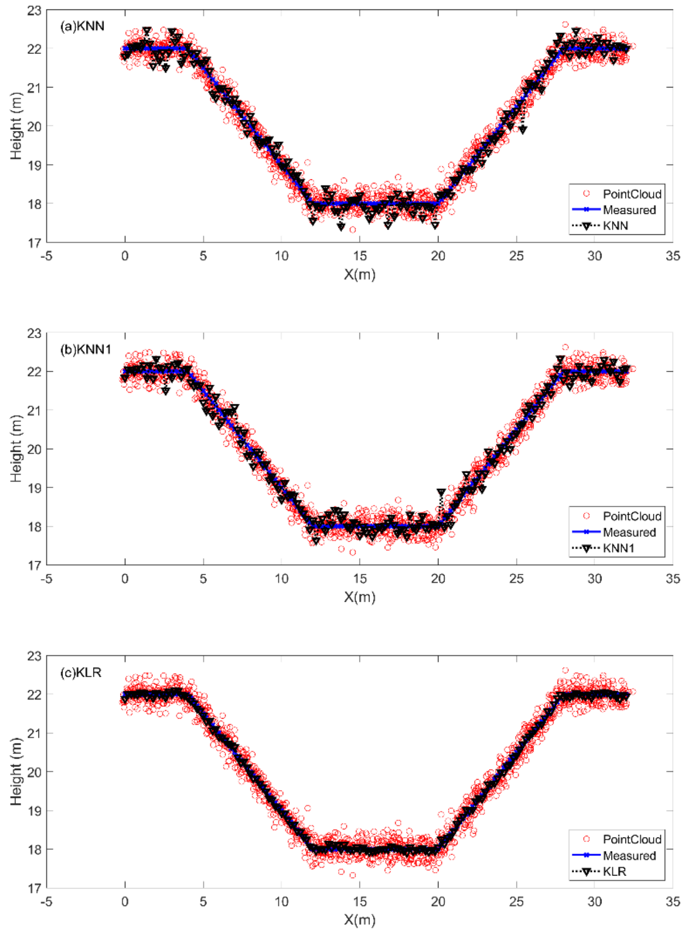

Figure 5. Different KNN-based methods to estimate the synthetic trapezoidal channel as (a)KNN, (b)KNN1, and (c)KLR models. Note that (1) the KNN model was reproduced from the original

paper of Lall and Sharma (1996); and (2) the KNN1 model (i.e. k=1) indicates that the closet point was used to demarcate the channel.

► Major Comment 6

page 13, line 236, there is a lack of relevant experiments or references regarding the suggestion of overlapping parts.

Response ◄

The authors appreciate this comment and relevant references were added accordingly.

► Major Comment 7

All images are at the end of the article, which is not conducive to reading.

Response ◄

All images were located at the end of the article for the easy writing purpose. The images will be relocated to the places that are mentioned in the text. Hope this circumstances is acceptable to this reviewer.