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Interactive comment on "Morphometric properties of alternate bars and water discharge: a laboratory investigation" *by* Marco Redolfi et al.

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Summary of Review

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This manuscript was enjoyable to read and was quite interesting. I have no serious concerns with the current manuscript, and I am a proponent of using 'signal analyses' to examine physical phenomena, and thus I applaud the authors for using Fourier analyses to provide a relatively objective quantifiable metric, or signal, to look for when evaluating alternate bars. This technique certainly has many other applications beyond bar theory.

Overall, I recommend publication of this manuscript after 'minor' revisions (see follow-

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ing).

There are a number of very 'minor' corrections, however, which need addressing. There are several structural/grammatical errors, which I have provided possible corrections for (or are highlighted) in the 'Track Changes' PDF file accompanying this general review document. In addition, I have posed a number of comments/questions (see below) that the authors may want to explore to 'round out' their current manuscript, and to connect their findings more generally to the inherent grain size continuum observed when considering the range of naturally occurring fluvial systems.

Main Focus of Manuscript

1. To compare, contrast, and test, existing alternate bar formation models and observations with newly acquired experimental alternate bar results accompanied by Fourier analyses.

Research Questions

1. How do geometrical properties of alternate bars depend on water discharge?

2. Is it possible to identify different bar styles depending on flow conditions?

3. Is there a sharp transition from alternate bar morphology to a plane-bed configuration?

General Reviewer Comments and Questions

1. The authors use the words 'bars' and 'bedforms' interchangeably throughout the manuscript. These two features are not 'identical'. In the 'Track Changes' PDF file uploaded with this general review, I have provided suggestions throughout the manuscript as to how to correct this error. In general, 'bedforms' refer to ripples and dunes (do not deflect, or steer, a large percentage of channel water mass), whilst 'bars', or 'barforms' do deflect, or steer, a large percentage of channel water mass. Thus, when the authors refer to the entire spectrum of morphologic elements of a bed (i.e., bedforms to

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barforms) they should use a generic, or more neutral, term such as: 'bed features', or 'morphologic bed features', whilst when they refer to specific elements they see in their experiments they should use: i) bars or barforms, or ii) bedforms, under the appropriate conditions. I have made many of these corrections in the 'Track Changes' PDF file, but the authors should review this throughout their manuscript to ensure consistency.

2. What other morphodynamic applications can the Fourier analysis methods presented in this study be used for??

-This is an important aspect of the paper for the community at large, and it would be useful for the authors to address this question in a few lines of text.

3. When expanding the results of this study to other systems (e.g., low slope, smaller grain size), what becomes more important the Froude #, sediment transport mode (i.e., bedload, mixedload, or suspended-load), or sediment transport rates??

I realize that the answer to this question is unlikely to be straightforward, but it would be interesting to hear the author's thoughts. For instance, large deep, rivers almost always have Froude #s below criticality, and move between bedload dominated, mixed-load dominated, and suspended-load dominated, due to smaller grain size distributions and varying discharges. Are alternate bars, or diagonal bars, expected to develop under these conditions?? If so, when do these conditions arise relative to the bedload dominated experiments of this study??

-Diagonal bars are very rare, if not always absent, in silt to sand bed systems, but 'free bars' or 'alternate bars' are observed in these types of systems (especially in straight reaches)

4. Are alternate bars and diagonal bars relegated to just bedload transport conditions?? It seems that if these experiments were run at even higher flow discharges, or at steeper slopes, one would induce significant suspended-sediment transport, or high enough sediment transport rates, which potentially would erode, or 'flatten', all

'bars' leading to channel bed washout. Thus, is there a limitation on slope regarding development of alternate bars, or diagonal bars, for a given grain size??

-This limit might be better constrained by sediment transport rates as a function of shear stress??, or a higher slope just lessens the time to equilibrium conditions for a given constant discharge due to higher transport rates, or shear stresses??

-It might be interesting to think about a plot of shear stress vs grain size for given slopes to bracket, or constrain, the conditions where alternate bars, or diagonal bars, are predicted to readily form??, or not form??. Then look to see what natural systems fall within these boundaries??

5. Are the results of this study expandable as the width to depth ratio and discharge increase in step??

-To reach the identical results of this study in a flume with a larger width to depth ratio, but all other conditions equal, the discharge must be increased by some value that will equate, or scale, with the metrics measured, calculated, or observed, in this study.

-This means that there might exist a non-dimensional characteristic discharge, Q_w, which will recreate your results across the width to depth spectrum. For instance, this could be in the form of percentage of bankfull discharge, Q_bf (i.e., Q_w/Q_bf)?? that will correspond to all (9) discharge conditions used in this study.

I am aware that additional experiments, or field studies, are likely necessary to resolve all, or any individual, question(s) above, but it would be useful for the author's to address this at some level in their current manuscript. I do think their results provide enough ammunition to propose a few new hypotheses, thoughts, or ways to test, the topics/ideas raised in this review.

However, I do not expect the authors to address all of the ideas or questions posed above at a deep, or significant level, they are simply 'food for thought'.

Please also note the supplement to this comment:
https://esurf.copernicus.org/preprints/esurf-2020-27/esurf-2020-27-RC2-supplement.pdf

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