Is There a Robust Technique for Selecting Aspect Ratios in Line Charts? (Supplemental Material)

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This supplemental material file provides additional information along with the TVCG submission "Is There a Robust Technique for Selecting Aspect Ratios in Line Charts?". We provide (1) definitions of the acronyms for various aspect ratio selection methods (see Table I below); (2) the analysis for the threshold in determining if the median filter smoothing is required; (3) another example of applying dual-scale banking to the *hsales* data; and (4) complete results for plots over all different methods for all 1D and 2D data sets.

Acronyms. Table I lists the full names and abbreviations of all existing aspect ratio selection methods, among which L_1-LOR is our proposed technique.

TABLE I Full names and corresponding abbreviations of various aspect ratio selection methods.

Name of Method	Abbr.
Median Absolute **S**lope	MS
Average Absolute **S**lope	AS
Average Absolute **O**rientation	AO
Arc Length **W**eighted Average Absolute **O**rientation	AWO
Global **O**rientation **R**esolution	GOR
Local **O**rientation **R**esolution	LOR
$\boldsymbol{L_1}$-norm based **L**ocal **O**rientation **R**esolution	L_1-LOR
Resultant **V**ector	RV
Arc **L**ength	AL

Threshold analysis. Dual-scale banking is built upon the RV and L_1-LOR methods to select aspect ratios, thus enabling us to take their advantages to effectively reveal patterns of interest in different scales. However, since both RV and L_1-LOR have the limitation of selecting extremely small aspect ratios for data with strong spike noise (see Section 5.6 in the paper), we thus suggest to apply a median filter to first smooth out the spike noise in the data and select aspect ratios on the smoothed data.

When the amount of spike noise increases, the average absolute orientation of the input data quickly increases; see Fig.14(d) in the paper. Thus, we take the value of average absolute orientation to decide if a median filter smoothing is required. To find the threshold value, we take two representative data sets with distinctive temporal patterns, i.e., *9-13* and CO_2 (see Figs. 1 (a,d)), and add varying amount of spike noise (denoted by λ) to the data sets in this analysis. Figs. 1 (b,e) plot the relationships between the aspect ratios selected by RV and L_1-LOR against λ of these two data sets, where we can see that the selected aspect ratio becomes extremely small when λ increases to 0.2 and 0.02 in these two cases, respectively. By this analysis, we investigated how the average absolute orientation of the data varies with λ. From Figs. 1 (c,f), we can see that the average absolute orientations quickly increase to about 75°, and thus, we empirically set the threshold as 75°.

House sales. To further demonstrate the effectiveness of our dual-scaling banking, we applied it to the time series (*hsales*) [1], which records the monthly sales of new one-family houses sold in the USA. We use the data from Jan. 1973 to Nov. 1995. From Figs. 2(a,b), we can see that direct applications of RV and L_1-LOR to the data generate two similar plots, both with small aspect ratios, where one single fluctuating pattern can be revealed. By applying dual-scale banking to the data after median filtering (see the red curves in Figs. 2(c,d)), we can generate two new aspect ratios and produce Fig. 2(c), which highlights the seasonal patterns, and Fig. 2(d), which better reveals the details together with some outliers (peaks and valleys).

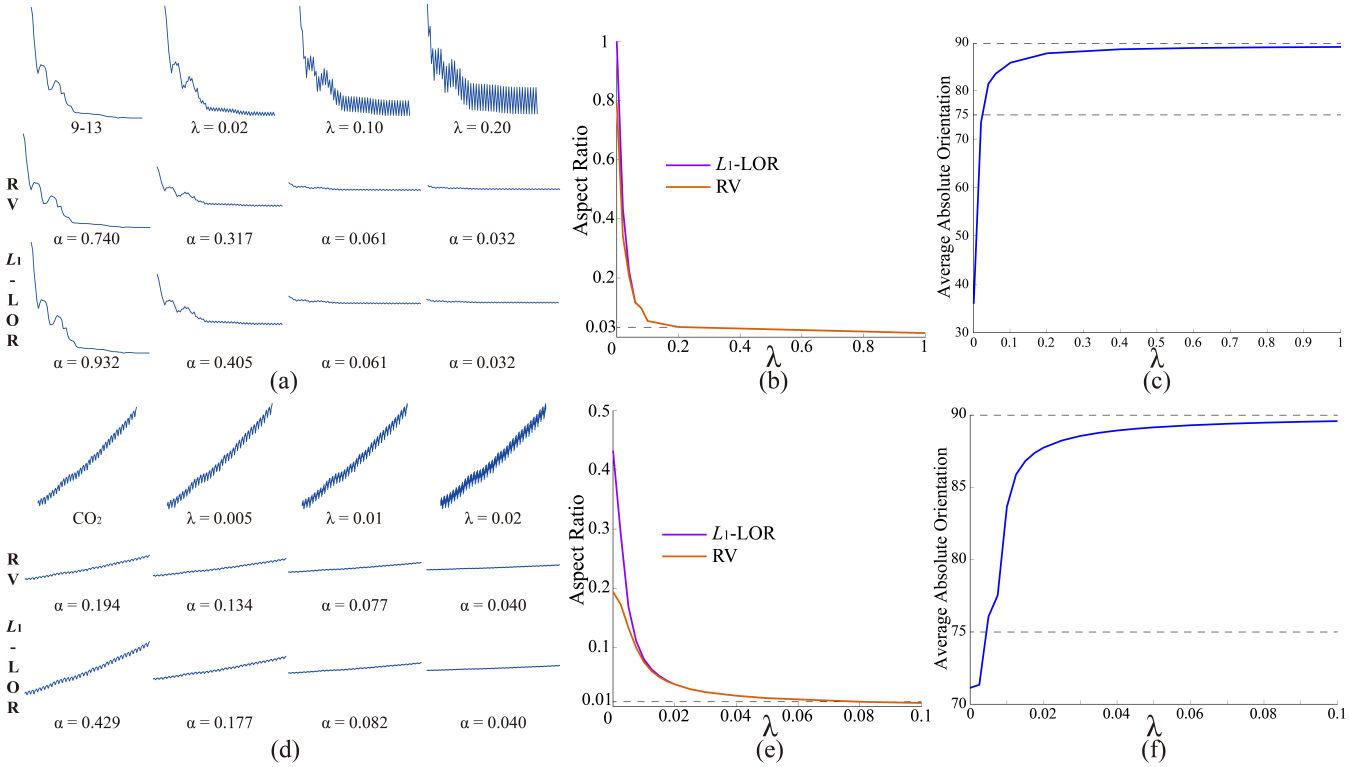

Fig. 1 Exploring the threshold on the average absolute orientation by adding varying amounts of spike noise (increasing λ) to data sets *9-13* (top row) and CO_2 (bottom row). (a,d) show the input data, the synthesized data with varying amounts of spike noise, and the corresponding curves plotted with the aspect ratios selected by RV and L_1-LOR; (b,e) show the relationships between the aspect ratios selected by L_1-LOR and RV against λ; and (c,f) show the relationship between the average absolute orientation of the synthesized data (with varying amount of spike noise) against λ.

REFERENCES

[1] R. Hyndman, "fma: Data sets from forecasting: methods and applications by makridakis, wheelwright & hyndman (1998)," *R package version*, vol. 2, 2009.

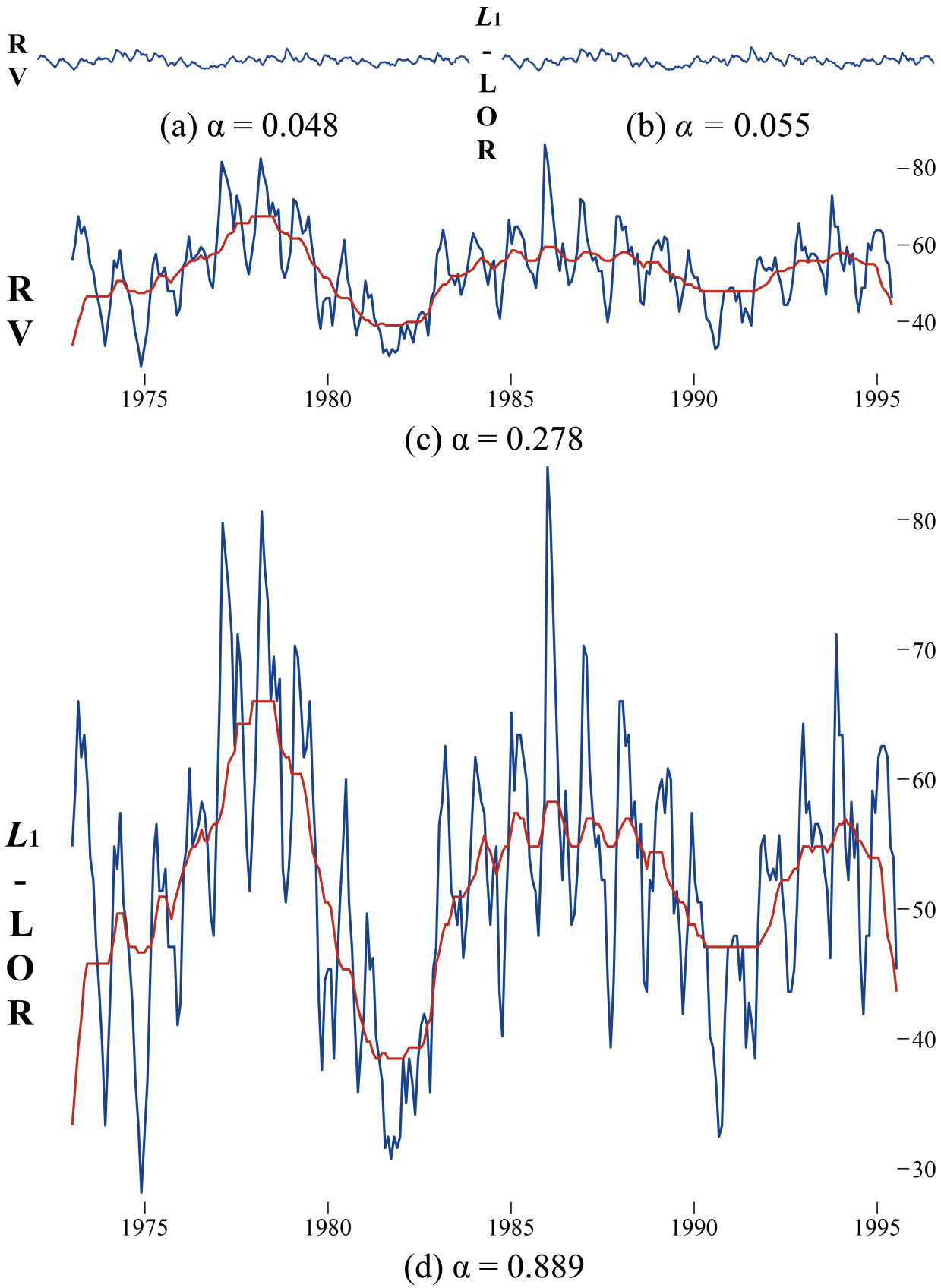

Fig. 2 Demonstrating the application of our dual-scale banking method to the house sales data (*hsales*). (a,b) Plots produced by directly applying RV and L_1-LOR to the original data. The resulting aspect ratios are both small, since the methods want to suppress the fast fluctuation. (c,d) results of dual-scale banking, where we apply RV and L_1-LOR to the median-filtered curve (in red), and produce two plots (one by RV (c) and one by L_1-LOR (d)) that reveal complementary patterns.

Comparison of the nine Aspect Ratio Selection Methods for 1D Curves

For high resolution results, please refer to our PROJECT PAGE

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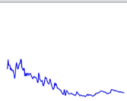
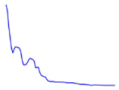
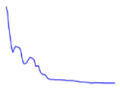
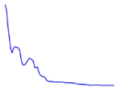
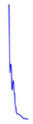
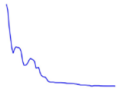
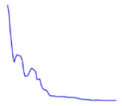
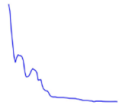
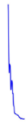
9-10									
9-13									
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boston									
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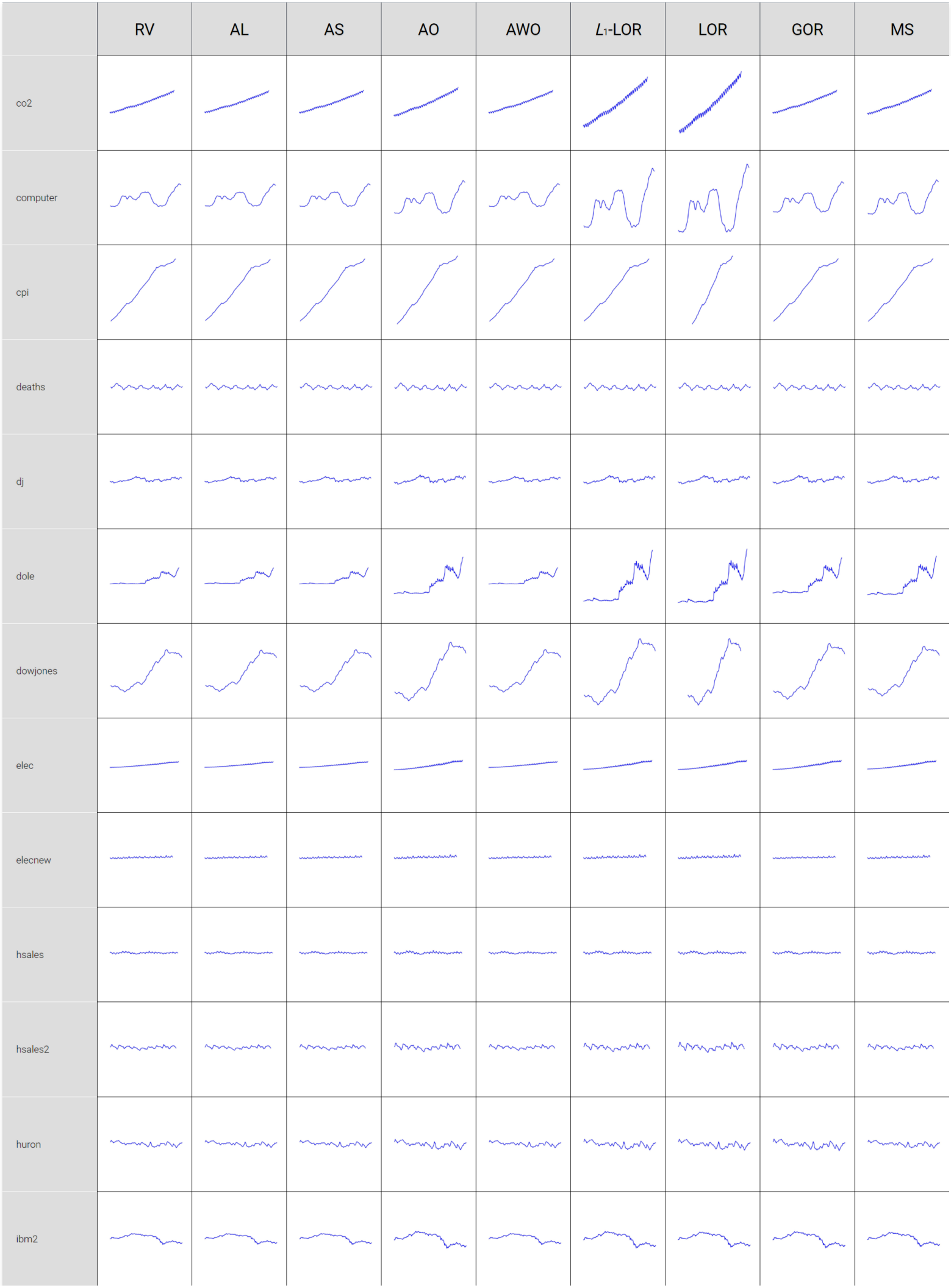
RV
AL
AS
AO
AWO
L_1-LOR
LOR
GOR
MS
co2
computer
cpi
deaths
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dole
dowjones
elec
elecnew
hsales
hsales2
huron
ibm2

	RV	AL	AS	AO	AWO	L_1-LOR	LOR	GOR	MS
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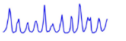
labour									
lynx									
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shampoo									
sheep									
stock1									
stock2									
stock3									
sunspot-y									
wagesuk									
wnoise									
writing									

Comparison of the nine Aspect Ratio Selection Methods for 2D Contours

For high resolution results, please refer to our PROJECT PAGE

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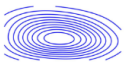
cars02									
catholic									
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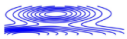
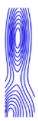
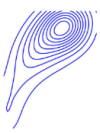
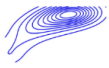
census									
cloud									
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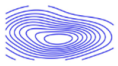
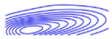
	RV	AL	AS	AO	AWO	L_1-LOR	LOR	GOR	MS
irissepal									
parkinsons									
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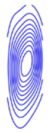
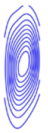
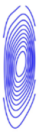
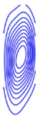
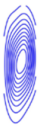
	RV	AL	AS	AO	AWO	L_1-LOR	LOR	GOR	MS
wine									
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