Aggregated Parallel Coordinates

Integrating Hierarchical Dimensions into Parallel Coordinates Visualisations

Keith Andrews
Graz University of Technology

Majda Osmić
AVL List GmbH

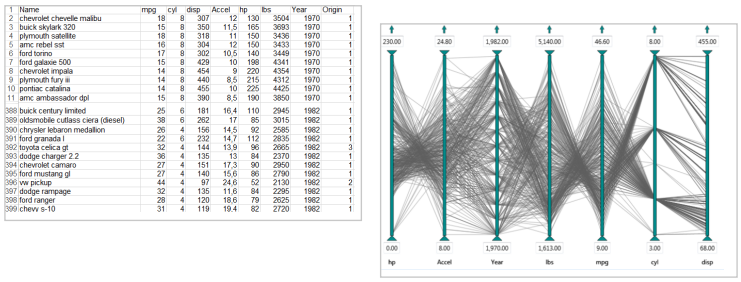
Gerhard Schagerl
AVL List GmbH

Abstract

Aggregated Parallel Coordinates (APC) are an extension of standard parallel coordinates, which support the visualisation and exploration of hierarchies within numerical dimensions. Such datasets can occur when data is available at several granularities and these can be grouped or aggregated in some way (mean, sum, max) to form higher levels of abstraction. While existing parallel coordinates techniques can be used to visualise individual dimensions of such data, they have no provision for interactively expanding and collapsing such hierarchically aggregated dimensions.

Parallel Coordinates

In traditional parallel coordinates (PC), dimensions are displayed as vertical parallel lines and records are displayed as horizontal polylines. Typical interactions include: filtering of records and repositioning of dimensions.



	Name	mpg	cyl	disp	Accel	hp	lbs	Year	Origin
2	chevrolet chevelle malibu	18	8	307	12	130	3504	1970	1
3	buick skylark 320	15	8	350	11,5	165	3693	1970	1
4	plymouth satellite	18	8	318	11	150	3436	1970	1
5	amc rebel sst	16	8	304	12	150	3433	1970	1
6	ford torino	17	8	302	10,5	140	3449	1970	1
7	ford galaxie 500	15	8	429	10	198	4341	1970	1
8	chevrolet impala	14	8	454	9	220	4354	1970	1
9	plymouth fury iii	14	8	440	8,5	215	4312	1970	1
10	pontiac catalina	14	8	455	10	225	4425	1970	1
11	amc ambassador dpl	15	8	390	8,5	190	3850	1970	1
388	buick century limited	25	6	181	16,4	110	2945	1982	1
389	oldsmobile cutlass ciera (diesel)	38	6	262	17	85	3015	1982	1
390	chrysler lebaron medallion	26	4	156	14,5	92	2585	1982	1
391	ford granada l	22	6	232	14,7	112	2835	1982	1
392	toyota celica gt	32	4	144	13,9	96	2665	1982	3
393	dodge charger 2.2	36	4	135	13	84	2370	1982	1
394	chevrolet camaro	27	4	151	17,3	90	2950	1982	1
395	ford mustang gl	27	4	140	15,6	86	2790	1982	1
396	vw pickup	44	4	97	24,6	52	2130	1982	2
397	dodge rampage	32	4	135	11,6	84	2295	1982	1
398	ford ranger	28	4	120	18,6	79	2625	1982	1
399	chevy s-10	31	4	119	19,4	82	2720	1982	1

Figure 1: The classic cars dataset, containing 399 records (cars) in 8 dimensions, displayed in traditional parallel coordinates.

Hierarchical Dimensions in Datasets

Sometimes, datasets have some inherent hierarchy within their dimensions. In the case of race car engineering simulations, dimensions (variables) such as Handling or Slip Angle are calculated for all three segments of every corner of a track. An analyst sometimes needs to look at an aggregate value, say an average value for the entire corner, or for all corner entry segments of the track.

No.	...	Handling C1Entry	Handling C1Mid	Handling C1Exit	...	Handling C21Mid	Handling C21Exit
1		-0.2	-0.3	-2		-0.3	-0.8
2		-2.8	-1.1	-1.0		-0.1	-0.3
...			...			...	
1000		-0.5	-0.7	-0.6		-0.9	-0.9

Figure 2: Hierarchically related dimensions in a race car simulation dataset.

Aggregated Parallel Coordinates

Aggregated parallel coordinates (APC) provide for hierarchical dimensions within a dataset to be expanded and collapsed interactively.

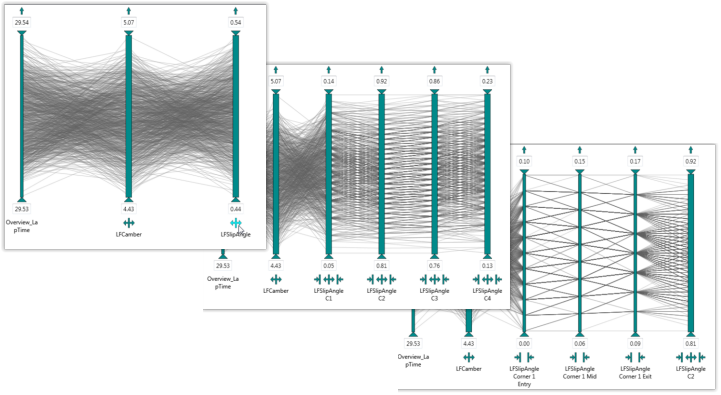


Figure 3: The left front slip angle (LFSlipAngle) has been expanded to show its four constituent corners. Corner 1 has then been further expanded to show its three constituent segment (entry, mid, and exit).

Application of APC in SimBook

APC have been integrated into AVL's SimBook tool for visual exploration of race car simulation data.

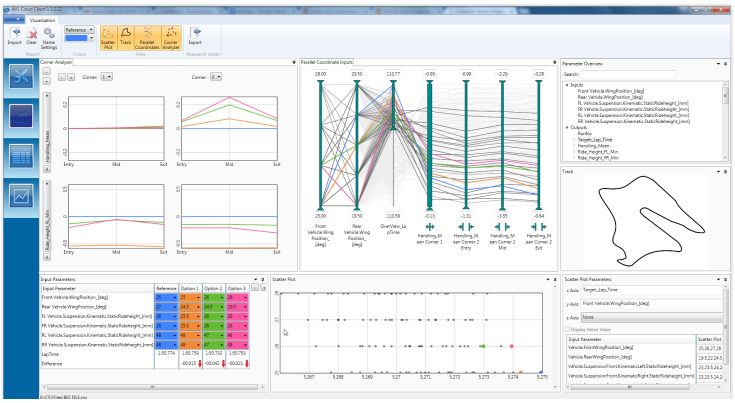


Figure 4: AVL's SimBook tool. APC are shown in the central panel. The variable (dimension) Handling Mean for Corner 2 has been expanded to show its Entry, Mid, and Exit components.

References

[1] Alfred Inselberg; *Parallel Coordinates*. Springer, 2009. ISBN 0470856181.

[2] Majda Osmić; *Aggregated Parallel Coordinates*. Master's Thesis, Graz University of Technology, 2015. http://ftp.iicm.tugraz.at/pub/theses/mosmic-2015-msc.pdf