Values from three simulations from SimThyr evaluated with ggmulti - High-Dimensional Visualizations.

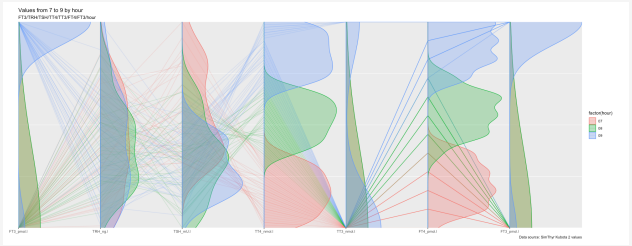
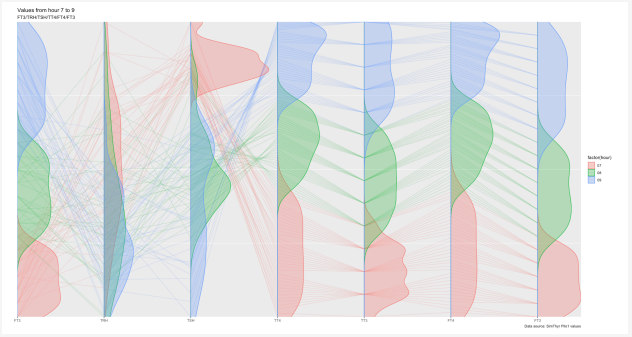
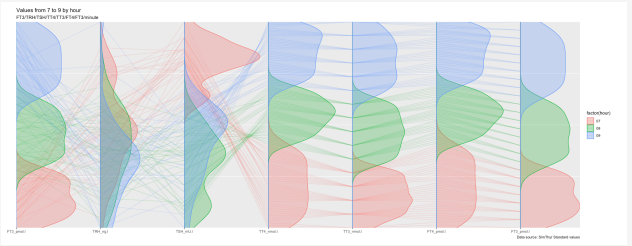
Paterns and explanations.

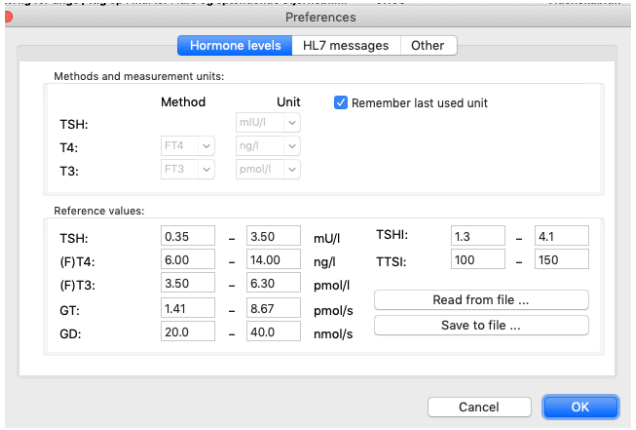
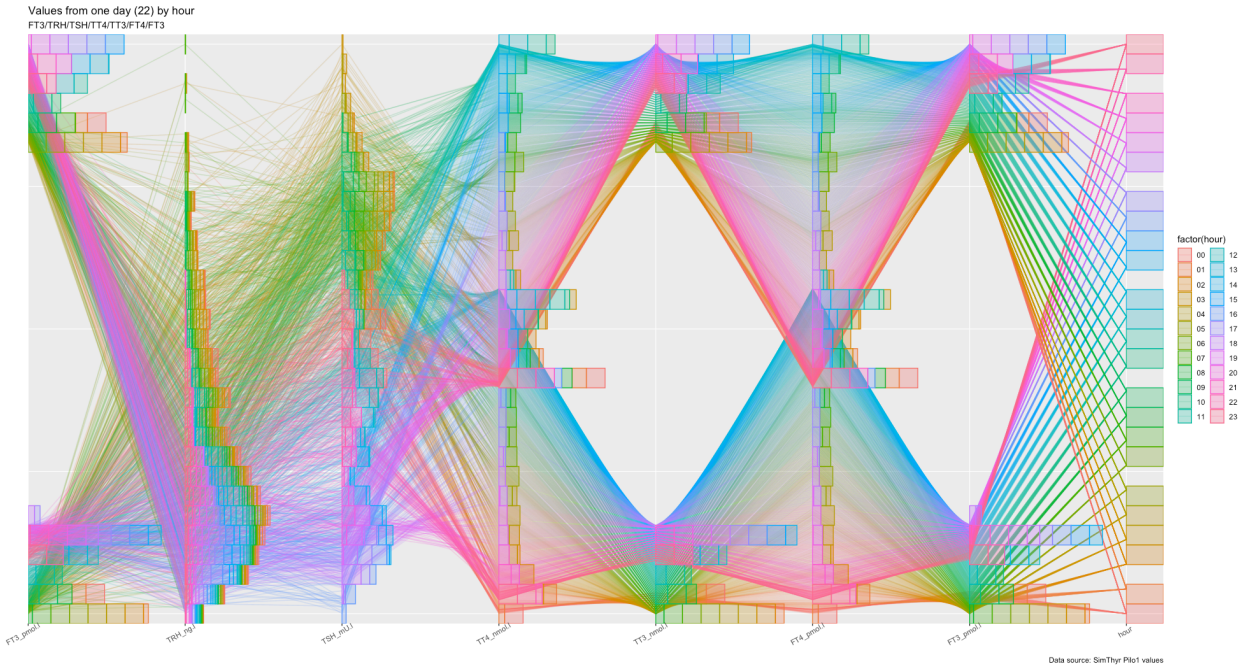
SimThyr is a simulation program for the pituitary thyroid feedback control that is based on a parametrically isomorphic model of the overall system that aims in a better insight into the dynamics of thyrotropic feedback. Applications of this program cover research, including development of hypotheses, and education of students in biology and medicine, nurses and patients.

https://sourceforge.net/p/simthyr/home/SimThyr/

You may find different scenarios build for SimThyr here: https://sourceforge.net/projects/simthyr/files/Scenarios/ The two files presented below are taken from these scenarios.

Below you find plots for three hours and later data for a day.

Kubota 2 (Case No. 2 from Kubota et al. showing overt hypothyroidism)	Pilo 1 (Case No. 1 from Pilo et al. showing slight hyperdeiodination and high conversion rate)	Standard
		
Looking at the density profiles for each of the hours 7 to 9 shows that there is only one value for TT3 and FT3 for the time 7 to 8 - which causes the algorithm to exclude the number. Apart from this we also see changes in the profiles for TSH compared to both Pilo 1 and the Standard figures.		

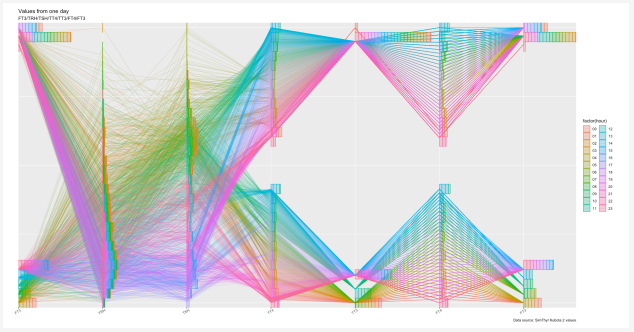
TSH: Min. 1st Qu. Median Mean 3rd Qu. Max. 37.64 54.56 70.43 69.41 81.98 124.07	TSH: Min. 1st Qu. Median Mean 3rd Qu. Max. 0.000 1.013 1.360 1.329 1.621 2.299	TSH: Min. 1st Qu. Median Mean 3rd Qu. Max. 1.048 1.568 2.074 2.030 2.454 3.451
FT3: Min. 1st Qu. Median Mean 3rd Qu. Max. 3.121 3.121 3.122 3.122 3.124 3.124	FT3: Min. 1st Qu. Median Mean 3rd Qu. Max. 6.942 6.945 6.962 6.962 6.980 6.983	FT3: Min. 1st Qu. Median Mean 3rd Qu. Max. 5.601 5.601 5.604 5.604 5.607 5.607
FT4: Min. 1st Qu. Median Mean 3rd Qu. Max. 6.441 6.442 6.445 6.445 6.447 6.448	FT4: Min. 1st Qu. Median Mean 3rd Qu. Max. 13.63 13.67 13.71 13.71 13.74 13.79	FT4: Min. 1st Qu. Median Mean 3rd Qu. Max. 18.47 18.49 18.52 18.53 18.57 18.59
		
Proposed reference intervals from SPINA-THYR	Units for the different parameters.	

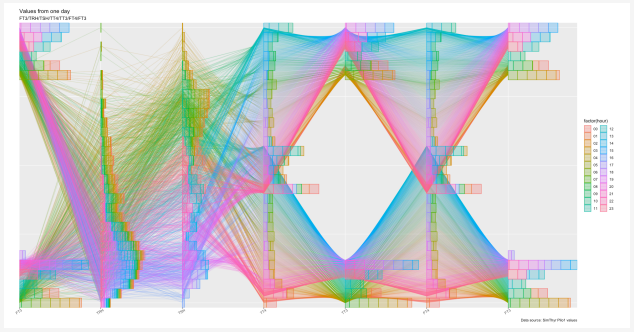
What does the algorithm do?

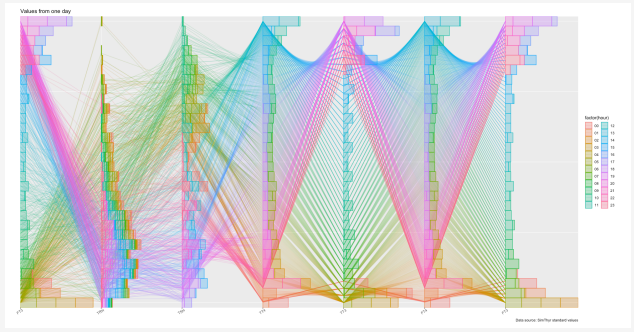
Parallel coordinates use parallel axes instead of perpendicular to represent dimensions of a multidimensional data set [25], [26]. A vertical line is used for the projection of each dimension or attribute, with the maximum and minimum values of each dimension usually scaled to the upper and lower boundaries on those vertical lines. A polyline made up of n-1 lines at the appropriate dimensional values connects the axes to represent an n-dimensional point. Georges Grinstein, Marjan Trutschl, Urška Cvek (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.103.528&rep=rep1&type=pdf)

Referring to https://link.springer.com/chapter/10.1007/978-4-431-68057-4_3 and https://link.springer.com/article/10.1007/BF01898350

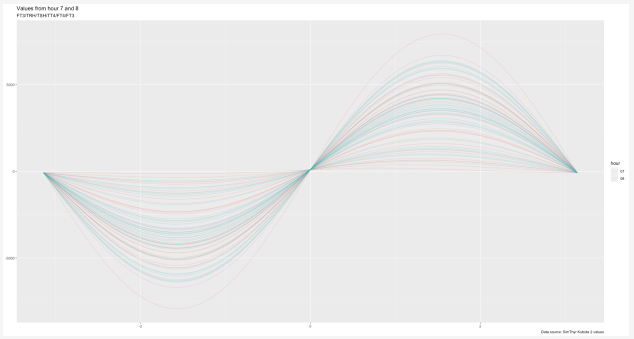
See also this reference: http://www.agocg.ac.uk/reports/visual/casestud/brunsdon/parallel.htm

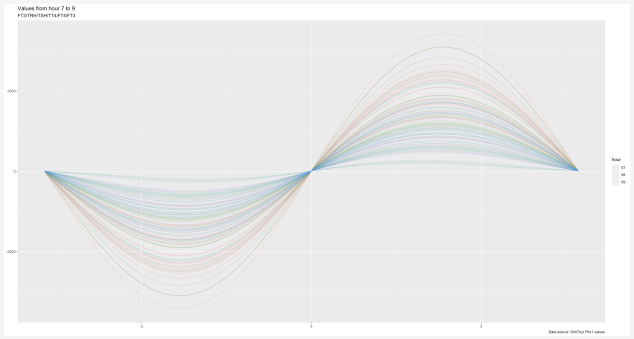


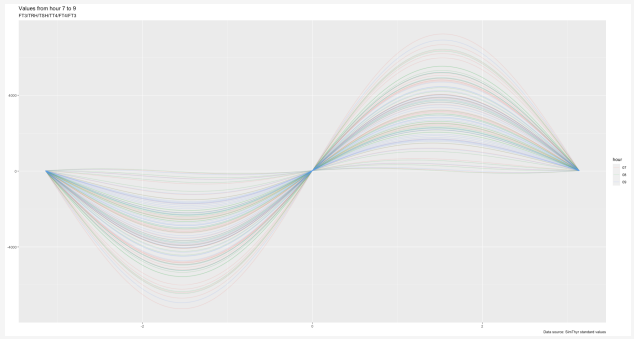




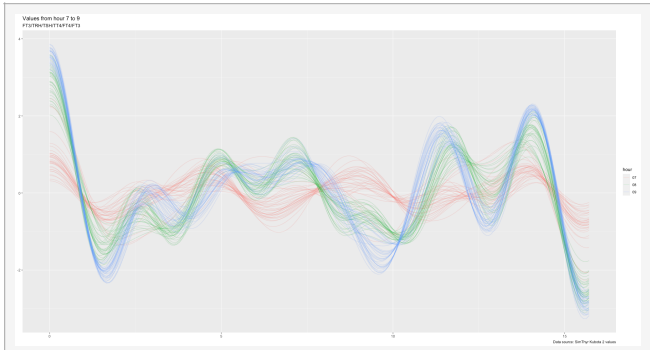
It is obvious that with disease the patterns changes, with the values for T3 and T4 are compressed or turned. The patterns for T3 are changed, less obvious are the changes in TRH and TSH.

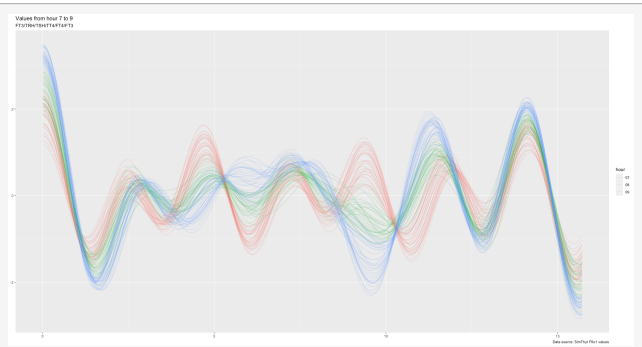


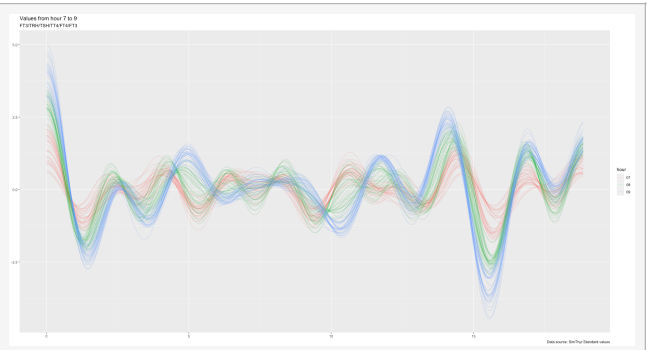




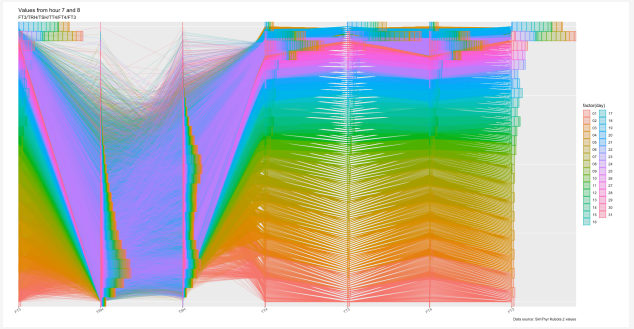
infinite axis

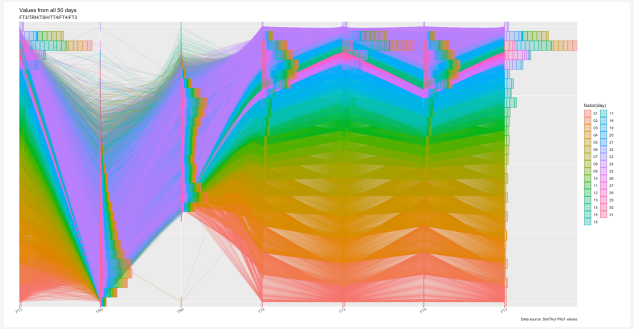


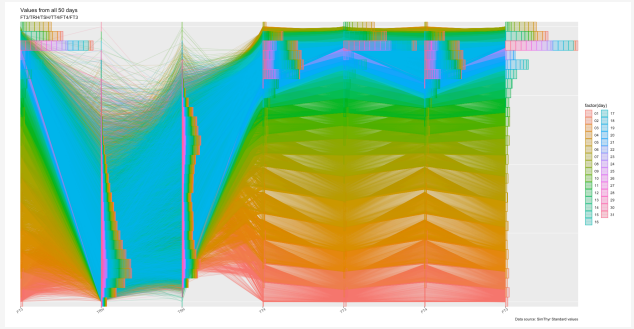




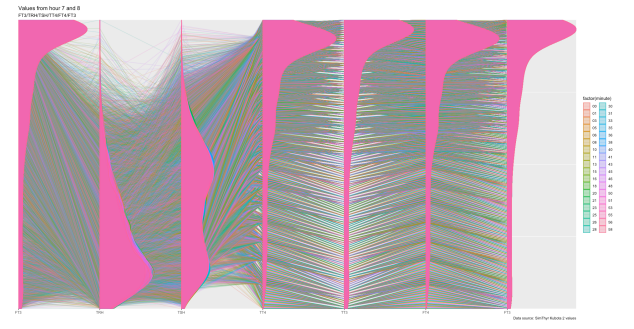
DAYS

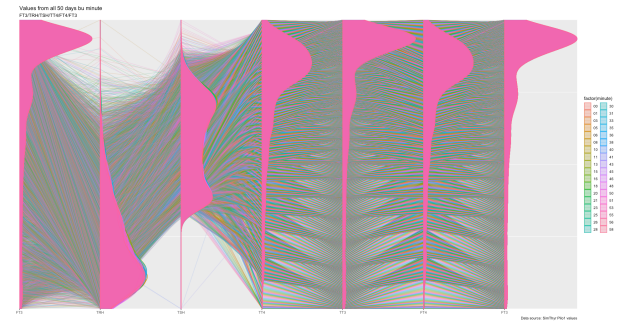


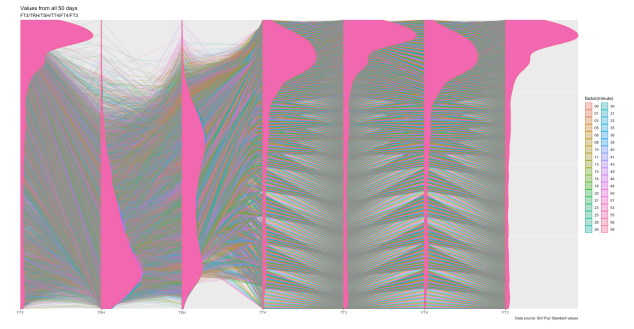


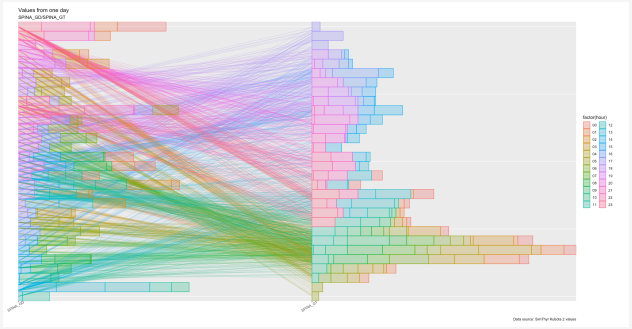
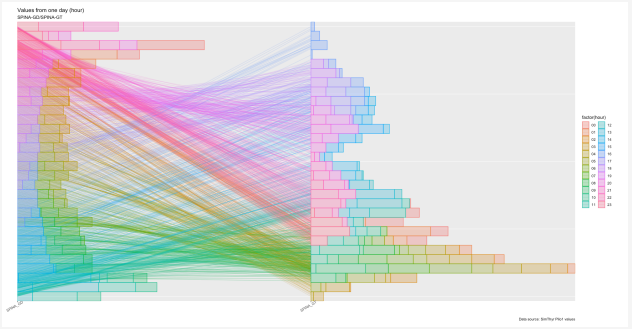
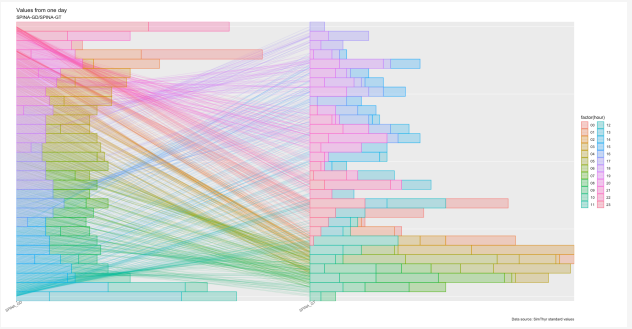


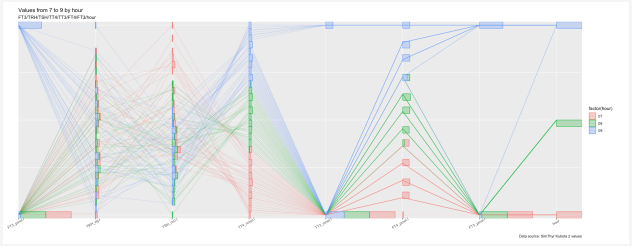
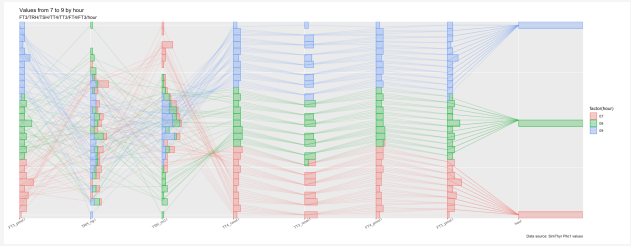
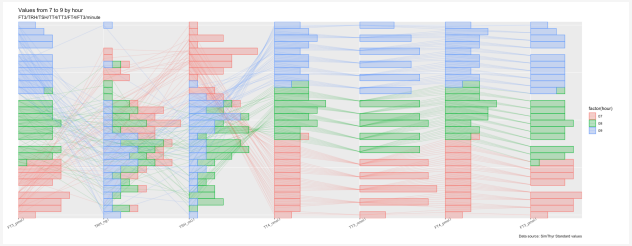
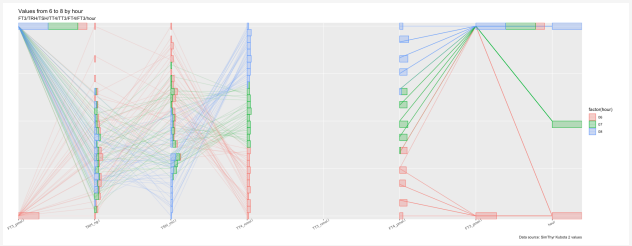
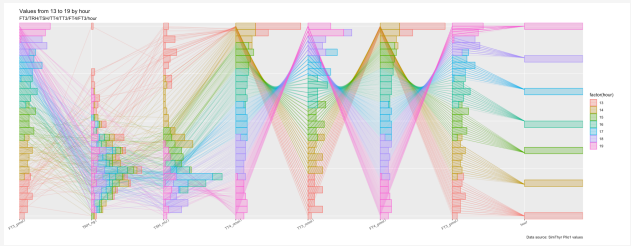
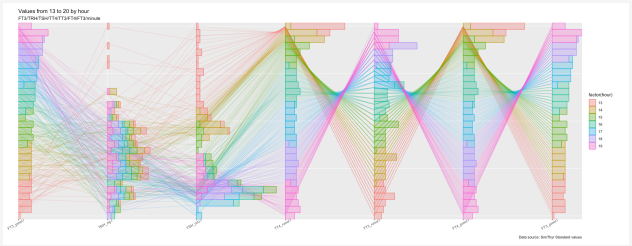
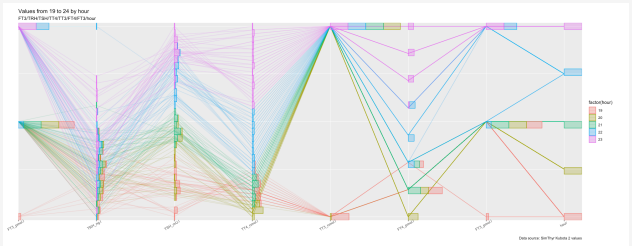
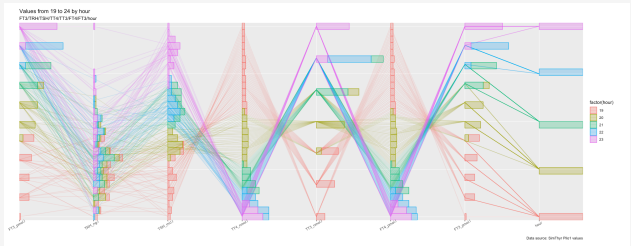
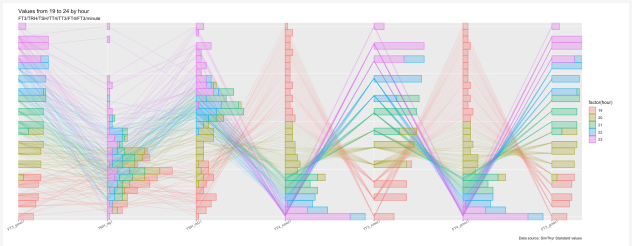
MINUTES







		
SPINA-GT: Min. 1st Qu. Median Mean 3rd Qu. Max. 0.5010 0.5051 0.5083 0.5101 0.5154 0.5239	SPINA-GT: Min. 1st Qu. Median Mean 3rd Qu. Max. 2.443 2.810 3.160 3.345 3.868 5.036	SPINA-GT: Min. 1st Qu. Median Mean 3rd Qu. Max. 2.681 2.966 3.317 3.447 3.906 4.734
SPINA-GD: Min. 1st Qu. Median Mean 3rd Qu. Max. 44.78 44.79 44.80 44.80 44.80 44.81	SPINA-GD: Min. 1st Qu. Median Mean 3rd Qu. Max. 46.78 46.84 46.95 46.96 47.08 47.13	SPINA-GD: Min. 1st Qu. Median Mean 3rd Qu. Max. 27.87 27.91 27.97 27.97 28.03 28.05
19 - 24 - TT3_nmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 1.864 1.864 1.864 1.864 1.864 1.864	19-24 - TT3_nmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 3.999 3.999 3.999 3.999 3.999 3.999	19-24 - TT3_nmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 3.223 3.223 3.224 3.224 3.224 3.224
19 - 24 - FT3_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 3.102 3.102 3.102 3.102 3.102 3.102	19 - 24 - FT3_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 6.653 6.654 6.654 6.654 6.654 6.654	19 - 24 - FT3_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 5.363 5.363 5.364 5.364 5.364 5.365
19 - 24 - FT4_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 6.405 6.405 6.405 6.405 6.405 6.405	19 - 24 - FT4_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 13.10 13.10 13.11 13.11 13.11 13.13	19 - 24 - FT4_pmol.l Min. 1st Qu. Median Mean 3rd Qu. Max. 17.75 17.75 17.75 17.75 17.76 17.77
19 - 24 - TSH_mU.l Min. 1st Qu. Median Mean 3rd Qu. Max. 45.24 55.01 62.45 63.84 73.62 81.80	19 - 24 - TSH_mU.l Min. 1st Qu. Median Mean 3rd Qu. Max. 0.7432 0.9606 1.0764 1.0639 1.1548 1.3557	19 - 24 - TSH_mU.l Min. 1st Qu. Median Mean 3rd Qu. Max. 1.344 1.567 1.722 1.685 1.788 2.030

		
		
		
Significance - add to the obvious from these images that FT3/TT3 has a very narrow index compared to TSH. FT3 and TT3 are very stable within the different time periods compared to TSH and TRH.	Novelty - for me it is new how narrow the index for FT3 and TT3 are (In the model). Another pattern from some of the images points out that some advanced mathematics is needed for explaining the torsion seen. See Inselberg below.	This points at a carefull judgement of the free T3 values as the changes may occur in the third or fourth place after the comma.

An animated version of the data you may find here: https://www.glensbo.dk/Simthyr/ (Google Chrome ok but Firefox/Safari may cause trouble?)
Inselbergs work: http://www.ifs.tuwien.ac.at/~mlanzenberger/teaching/ps/ws04/stuff/auth/00146402.pdf

	KUBOTA				PILO				STANDARD				Ref interval		
	Min	Max	Diff.	Diff.R.I./Diff.	Min	Max	Diff	Diff.R.I./Diff.	Min	Max	Diff	Diff.R.I./Diff.	Min	Max	Diff
TSH	37,64	124,07	86,43	0,0365	0	2,299	2,299	1,3702	1,048	3,451	2,403	1,3109	0,35	3,5	3,15
FT3	3,121	3,124	0,003	933,3333	6,942	6,983	0,041	68,2927	5,601	5,607	0,006	466,6667	3,5	6,3	2,8
FT4	6,441	6,448	0,007	1142,8571	13,63	13,79	0,16	50,0000	18,47	18,59	0,12	66,6667	6	14	8