ProPer_RPT: WTF?

The ProPer workflow extracts continuous F0 and corresponding periodic energy curve to visualize and measure prosodic aspects of speech. We measure the following 3 "primitives" within syllabic intervals:
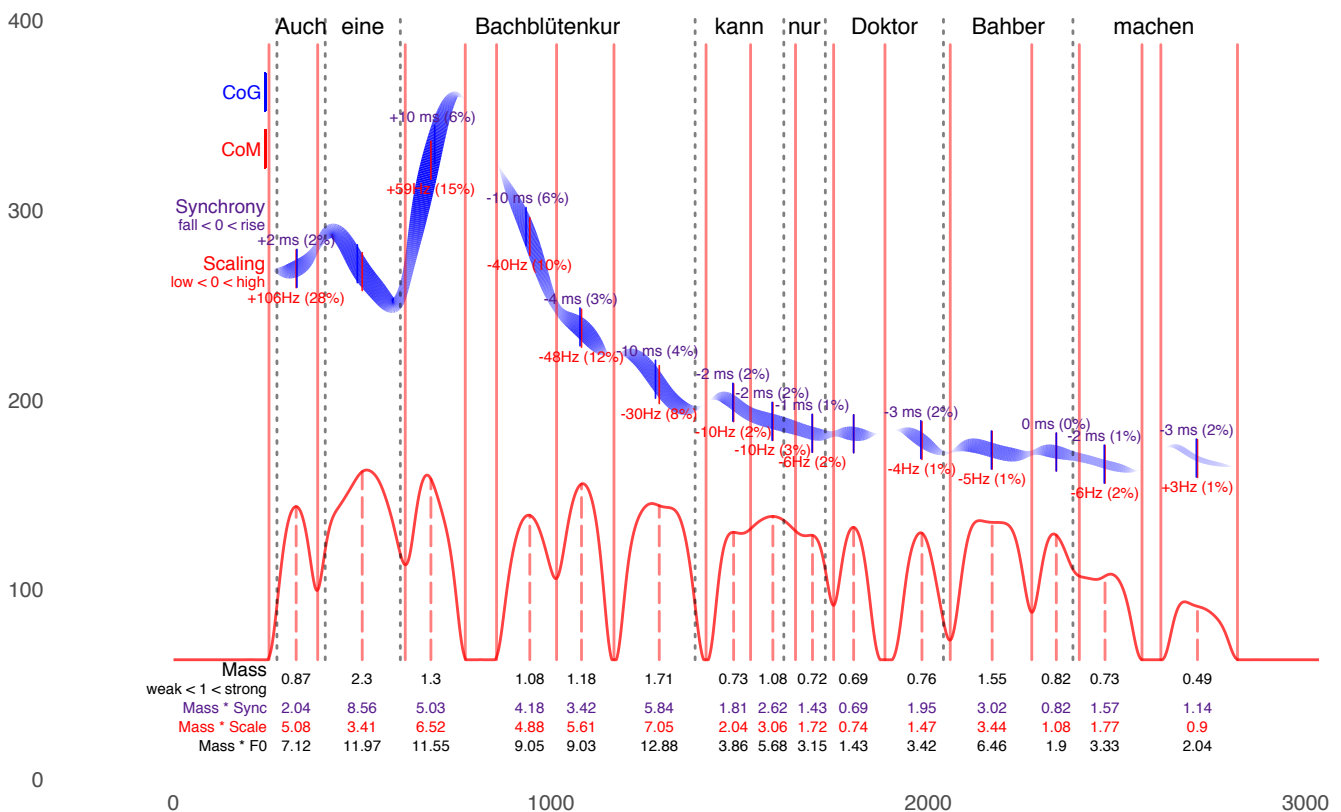
I) Mass / AUC

area under the periodic energy curve denoting the prosodic strength.

II) Scaling

F0 change across syllables.

III) Synchrony

F0 change within a syllable.

Figure labels (top): Auch eine · Bachblütenkur · kann · nur · Doktor · Bahber · machen

Left-axis labels: CoG · CoM · Synchrony (fall < 0 < rise) · Scaling (low < 0 < high)

	Auch	eine		Bachblütenkur			kann	nur		Doktor		Bahber			machen
Mass (weak < 1 < strong)	0.87	2.3	1.3	1.08	1.18	1.71	0.73	1.08	0.72	0.69	0.76	1.55	0.82	0.73	0.49
Mass * Sync	2.04	8.56	5.03	4.18	3.42	5.84	1.81	2.62	1.43	0.69	1.95	3.02	0.82	1.57	1.14
Mass * Scale	5.08	3.41	6.52	4.88	5.61	7.05	2.04	3.06	1.72	0.74	1.47	3.44	1.08	1.77	0.9
Mass * F0	7.12	11.97	11.55	9.05	9.03	12.88	3.86	5.68	3.15	1.43	3.42	6.46	1.9	3.33	2.04

Mass has no meaningful absolute values so it is only presented in relative scale (mass is calculated to yield '1' for an average strength in a given utterance). However, scaling and synchrony do not measure quantities and their point of equilibrium is zero such that positive values denote rises and negative values denote falls. These are measures in absolute terms — distance in milliseconds for synchrony and distance in Hz for scaling. We also provide their relative interpretation that considers F0 change in absolute terms (no negatives). We measure the synchrony distance relative to the given interval duration, and the scaling distance relative to the speaker's F0 range. These give us the following 5:

1) *AUC_rel* (relative mass)

2) *scaling* (absolute scaling)

3) *scaleRel* (relative scaling)

4) *synchrony* (absolute synchrony)

5) *syncRel* (relative synchrony)

In the context of the current study, we also test combinations of these features such that the mass can modulate the details of F0 change by multiplication (capitalizing on the fact that '1' denotes average strength). We multiply only the relative versions of the F0-related measurements, and we log-transform them to keep scores positive and within a limited range that seems to make sense. The first type of combination yields two measurements:

6) *massXscale*

mass * log2(scaling%)

7) *massXsync*

mass * log2(synchrony%)

Lastly, we provide an all-in-one measurement that simply adds the two complex measurements to suggest a single value that incorporates strength of syllable and F0 changes occurring in it, whether by local rise/fall (synchrony) or by virtue of a large change from the previous syllable (scaling):

8) *massXf0* (massXscale + massXsync)

Since these are all syllabic values we attribute them to words in the following way: a syllable be-longs to a word if the the Center of Mass of that syllable falls within the word interval (provided by manual segmentation of words). Thus, for each word we have 2 ways to extract values: i) maximal values (i.e. the strongest syllable) or; ii) average values. The average is only given as a test. There's no gret reason to think that it should be better than the maximal value. The word measurements accordingly prefix the term 'scoreMax' to the max-based measurements and 'scoreMean' to the average ones. The final 16 variables are therefore:

scoreMax_synchrony, scoreMean_synchrony, scoreMax_syncRel, scoreMean_syncRel,

scoreMax_Mass, scoreMean_Mass

scoreMax_scaling, scoreMean_scaling, scoreMax_scaleRel, scoreMean_scaleRel,

scoreMax_massXsync, scoreMean_massXsync, scoreMax_massXscale, scoreMean_massXscale

scoreMax_massXf0, scoreMean_massXf0