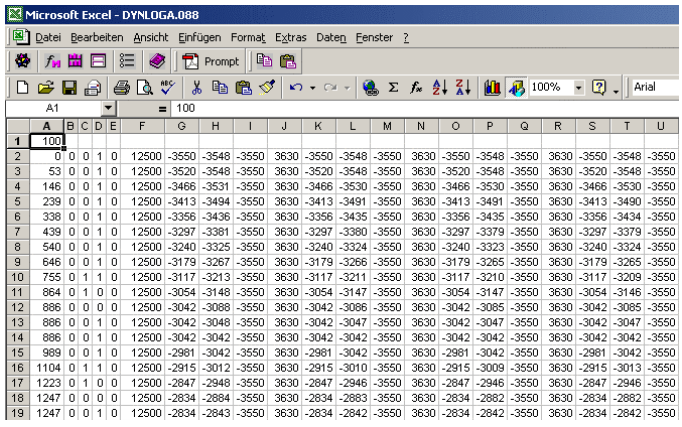
PocketLFC – The minimal LogFileCalculator V1.0 by H.Krauss (KFJ)

In this document, some details on the logfile analysis shall be discussed and further explained with an example.

Generation of the dynalog files

The dynalog files are generated on the MLC controller by pressing "F", and then "C" or "A" depending on the desired target drive. We prefer to write the files to the internal harddisk (C), because floppies may be corrupt and then the files are lost (they cannot be generated a second time). Furthermore, it takes less time to write the files to "C", exit MLCX, copy them to "A" via the DOS command "copy" and restarting the MLCX software than writing to "A" directly without the need to restart MLCX (writing to "A" is extremely slow). Especially if the DOS script "doit" is installed, the export of multiple dynalog files to "A" is very convenient, because the logs are zipped automatically with PKZIP, which shrinks them to about 2-4% of their original size and are kept in a ZIP archive on the controller. "Doit" is explained in a separate document ("doit.doc").

Contents of DYNLOGA.xxx and DYNLOGB.xxx



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	100																				
2	0	0	0	1	0	12500	-3550	-3548	-3550	3630	-3550	-3548	-3550	3630	-3550	-3548	-3550	3630	-3550	-3548	-3550
3	53	0	0	1	0	12500	-3520	-3548	-3550	3630	-3520	-3548	-3550	3630	-3520	-3548	-3550	3630	-3520	-3548	-3550
4	146	0	0	1	0	12500	-3466	-3531	-3550	3630	-3466	-3530	-3550	3630	-3466	-3530	-3550	3630	-3466	-3530	-3550
5	239	0	0	1	0	12500	-3413	-3494	-3550	3630	-3413	-3491	-3550	3630	-3413	-3491	-3550	3630	-3413	-3490	-3550
6	338	0	0	1	0	12500	-3356	-3436	-3550	3630	-3356	-3435	-3550	3630	-3356	-3435	-3550	3630	-3356	-3434	-3550
7	439	0	0	1	0	12500	-3297	-3381	-3550	3630	-3297	-3380	-3550	3630	-3297	-3379	-3550	3630	-3297	-3379	-3550
8	540	0	0	1	0	12500	-3240	-3325	-3550	3630	-3240	-3324	-3550	3630	-3240	-3323	-3550	3630	-3240	-3324	-3550
9	646	0	0	1	0	12500	-3179	-3267	-3550	3630	-3179	-3266	-3550	3630	-3179	-3265	-3550	3630	-3179	-3265	-3550
10	755	0	1	1	0	12500	-3117	-3213	-3550	3630	-3117	-3211	-3550	3630	-3117	-3210	-3550	3630	-3117	-3209	-3550
11	864	0	1	0	0	12500	-3054	-3148	-3550	3630	-3054	-3147	-3550	3630	-3054	-3147	-3550	3630	-3054	-3146	-3550
12	886	0	0	0	0	12500	-3042	-3088	-3550	3630	-3042	-3086	-3550	3630	-3042	-3085	-3550	3630	-3042	-3085	-3550
13	886	0	0	1	0	12500	-3042	-3048	-3550	3630	-3042	-3047	-3550	3630	-3042	-3047	-3550	3630	-3042	-3047	-3550
14	886	0	0	1	0	12500	-3042	-3042	-3550	3630	-3042	-3042	-3550	3630	-3042	-3042	-3550	3630	-3042	-3042	-3550
15	989	0	0	1	0	12500	-2981	-3042	-3550	3630	-2981	-3042	-3550	3630	-2981	-3042	-3550	3630	-2981	-3042	-3550
16	1104	0	1	1	0	12500	-2915	-3012	-3550	3630	-2915	-3010	-3550	3630	-2915	-3009	-3550	3630	-2915	-3013	-3550
17	1223	0	1	0	0	12500	-2847	-2948	-3550	3630	-2847	-2946	-3550	3630	-2847	-2946	-3550	3630	-2847	-2946	-3550
18	1247	0	0	0	0	12500	-2834	-2884	-3550	3630	-2834	-2883	-3550	3630	-2834	-2882	-3550	3630	-2834	-2882	-3550
19	1247	0	0	1	0	12500	-2834	-2843	-3550	3630	-2834	-2842	-3550	3630	-2834	-2842	-3550	3630	-2834	-2842	-3550

Fig.1: sample cutout of dynalog file (upper left corner)

Fig.1 shows a screenshot of the upper left corner of a sample file after opening it with Excel and specifying the comma (,) as the record separator.

The number in the field A1 is the Dynamic Plan Tolerance in raw scale (in units of 1/100mm at MLC level), that is given in the DVA file as mm at isocenter. So 100 means 2.0mm at isocenter. This parameter is just passed over from the DVA file and will be ignored from now on.

Then, each row contains a snapshot of different parameters. Every 50ms, a new line (which we will call "record" from now on) is added. It is not yet clear to which point of time (after beam-on) the first line exactly corresponds, but we assume it is t=0 ("beam-on") in this example, because of the first parameter:

column A, except for the A1 field, contains sort of dose fraction. It always starts with 0 (or a very low number, e.g., 8), and runs to 25000 (or a number close to it).

Column B gives the number of the segment of the DVA file that is currently executed. The first one, segment 0, is defined by the neighbouring shapes 0 and 1. Within a segment, planned leaf movement always is linear. Read the "DMLC implementation guide" on the details of shapes, segments and leaf movement.

Columns C and D contain flags: if the value in D is 1, it means that beam currently is on, otherwise off. If the C value is 1, it means that a hold-off is asserted. In Fig.1, you can see a delay: until row 10, beam is on (D2:D10), in row 10, a hold-off is asserted (C10). Maybe some leaves were not able to follow dose. But it takes another 100ms until the dose counter actually has stopped (A13). In the meantime (probably because the leaves have caught up), beam is set on again (D13). But it takes another 100ms (A15), until the dose counter gets new signal. The situation is quite similar to the person who hits the gas too apruptly in driving school, not expecting the acceleration. The rocking car movement is probably similar to the rocking leaf movement.

Columns E and F contain the values of the dose fractions that would correspond to the neighbouring shapes (the previous and the next shape of the DVA file). This can be more clearly seen in Fig.2, which is a clinical example. If the dose fraction exceeds a border value (A5, A7, A9, …), the "current segment" (col. B) and the "neighbouring" shapes change: the right neighbour (F4) becomes the left neighbour (E5) in the next record.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	100																				
2	0	0	0	1	0	150	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
3	39	0	0	1	0	150	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
4	112	0	0	1	0	150	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
5	185	1	0	1	150	275	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
6	260	1	0	1	150	275	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
7	337	2	0	1	275	425	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
8	415	2	0	1	275	425	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
9	496	3	0	1	425	575	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
10	579	4	0	1	575	700	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
11	661	4	0	1	575	700	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
12	748	5	0	1	700	850	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
13	835	5	0	1	700	850	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
14	923	6	0	1	850	1000	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
15	1014	7	0	1	1000	1125	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
16	1104	7	0	1	1000	1125	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
17	1199	8	0	1	1125	1275	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
18	1293	9	0	1	1275	1400	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
19	1388	9	0	1	1275	1400	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
20	1482	10	0	1	1400	1550	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
21	1575	11	0	1	1550	1700	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
22	1669	11	0	1	1550	1700	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
23	1764	12	0	1	1700	1825	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
24	1856	13	0	1	1825	1975	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
25	1947	13	0	1	1825	1975	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
26	2037	14	0	1	1975	2125	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
27	2128	15	0	1	2125	2250	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
28	2219	15	0	1	2125	2250	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
29	2311	16	0	1	2250	2400	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
30	2404	17	0	1	2400	2550	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
31	2496	17	0	1	2400	2550	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
32	2591	18	0	1	2550	2675	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
33	2685	19	0	1	2675	2825	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
34	2781	19	0	1	2675	2825	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910
35	2876	20	0	1	2825	2975	-910	-917	-910	-910	-910	-918	-910	-910	-910	-917	-910	-910	-910	-917	-910

Fig.2: another DYNLOGA, taken from a clinical DVA file

Starting with column G, all following columns contain leaf positions, in groups of four for each leaf. Columns G,H,I and J describe the movement of leaf 1, K,L,M,N correspond to leaf 2 and so on. Within each group, the first column contains the planned leaf positions ("where the leaves should have been according to the dose fraction in column A"), the second column contains the true leaf positions ("where the leaves really were"), and the third and fourth columns again correspond to the planned positions of the neighbour shapes. So the total width of the log file is 40*4=160 columns for leaf positions + 7 = 167 columns total. The number of rows is depending on the treatment time (treatment time in seconds * 20 + 1).

Leaf position details

Leaf positions are given in raw scale, in units of 1/100mm at MLC level. The direction is positive from the centerline outwards. The largest value is about 10000 (20cm@iso). In the example of Fig.2, it can be seen from columns H, L, P and T that the true positions of leaves 1, 2, 3 and 4 are slightly more negative (-917/-918) than they should be (-910). A similar picture is in the corresponding DYNLOGB file, which is not shown here. The reason for this is that whenever a leaf pair should be closed according to plan (planned positions A= -910, B= +910), the MLC controller software forces them to be even a little closer to each other in order to achieve a "sure touch". The windup tolerances take up the little extra play, in the logfiles the leaves seem to overlap (true positions A= -917, B= +902). Whenever the sum A+B is negative, there is windup.
It is difficult to tell from the logfiles alone where the leaves "really" are during DMLC delivery. The gap can be measured only in the static case, with a feeler gauge for certain leaf plans. We measured for planned A=0, B=0 a leaf gap of about 0.3mm (leaves do not touch), but the true leaf positions at the controller were given as A=-7, B=-8, which would mean windup. It is hard to tell whether the same rules apply for the static and the dynamic case. This is still a field for experiments if someone is interested in the old Mark MLC internals…

PocketLFC Example

1.) Copy the logfiles DYNLOGA.088 and DYNLOGB.088 to the same directory as the PocketLFC.exe and double-click the application.
2.) Enter 88 or 088 to specify the legs extension, hit Return.
3.) PocketLFC reads in the two logfiles and writes out "LPEA088.csv" and "LPEB088.csv", two files that contain the leaf position errors during the treatment.
4.) Double-click the file LPEA088.csv, Excel should start and format the data matrix. If not, start Excel manually, Open the csv file and specify the comma as the record separator. The spreadsheet now should look similar to the one shown in Fig.3.
5.) The columns A to AN stand for leaves A1 to A40, time runs from top to bottom. Activate all data, go to the diagram assistant and generate a line plot. The legend gives the correct leaf numbers, if the data range starts with column A (Fig.4). The leaf position error is displayed on the vertical axis, time or record number runs to the right. Each leaf is drawn with a certain line color which may look a little cluttered, but if one points with the mouse on a certain line, on gets the line (=leaf) number. Whenever a certain leaf has higher LPE than the others, it can easily be identified.
6.) Another way to display the same data is to exchange rows and columns in the diagram wizard. The only complication is that Excel cannot plot more than 255 lines simultaneously. So activate rows 165 through 195 (Fig.5) and plot this with rows and columns exchanged (Fig.6).

Care should be taken when identifying a certain row in the data matrix out of the plot. Now the offset has to be taken into account, because plotting does not start with row 1.

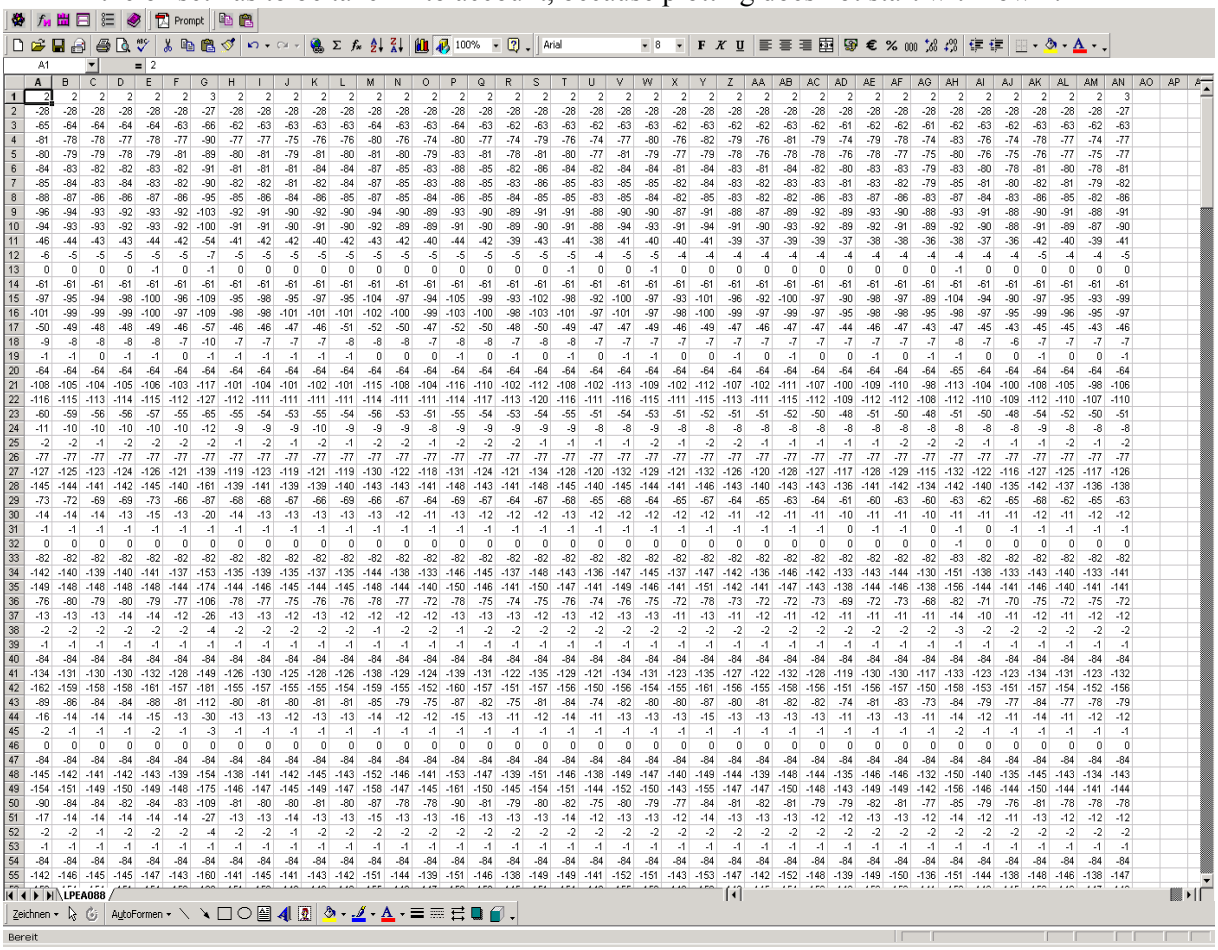


Fig.3: Sample leaf position error file LPEA088.csv

Some words about the example itself: the DVA file is contained in the distribution („LRAB.d00“. All leaves should move synchronously.
From the figures, no unusual behaviour (leaf position error) can be detected. The minor deviation of the leaf 7A movement (Fig.4) can also be detected in the ListDensityPlot generated with Mathematica® (Fig.7). But it’s not sure whether this is enough evidence to take a closer look at the leaf 7A hardware. The example should only demonstrate the most basic possibilities of the dynalog analysis with PocketLFC and the sensitivity of the method (deviations of 1/100mm can be detected in principle). The LPE of carriage B is not shown here because it is very similar. Of course, the carriages must be analysed separately.

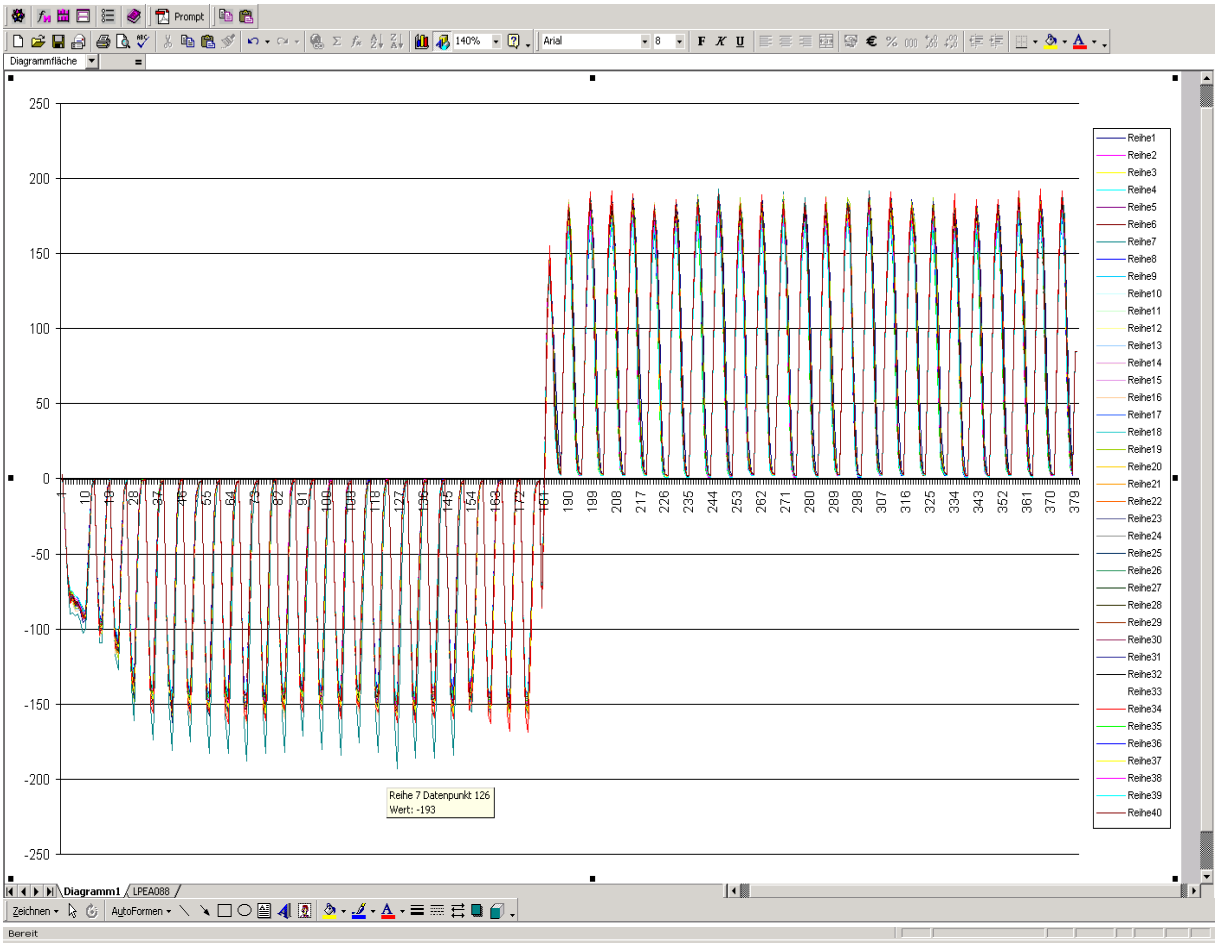


Fig.4: Line plot of data in Fig.3. Vertical axis: LPE, horizontal: record number (or time).

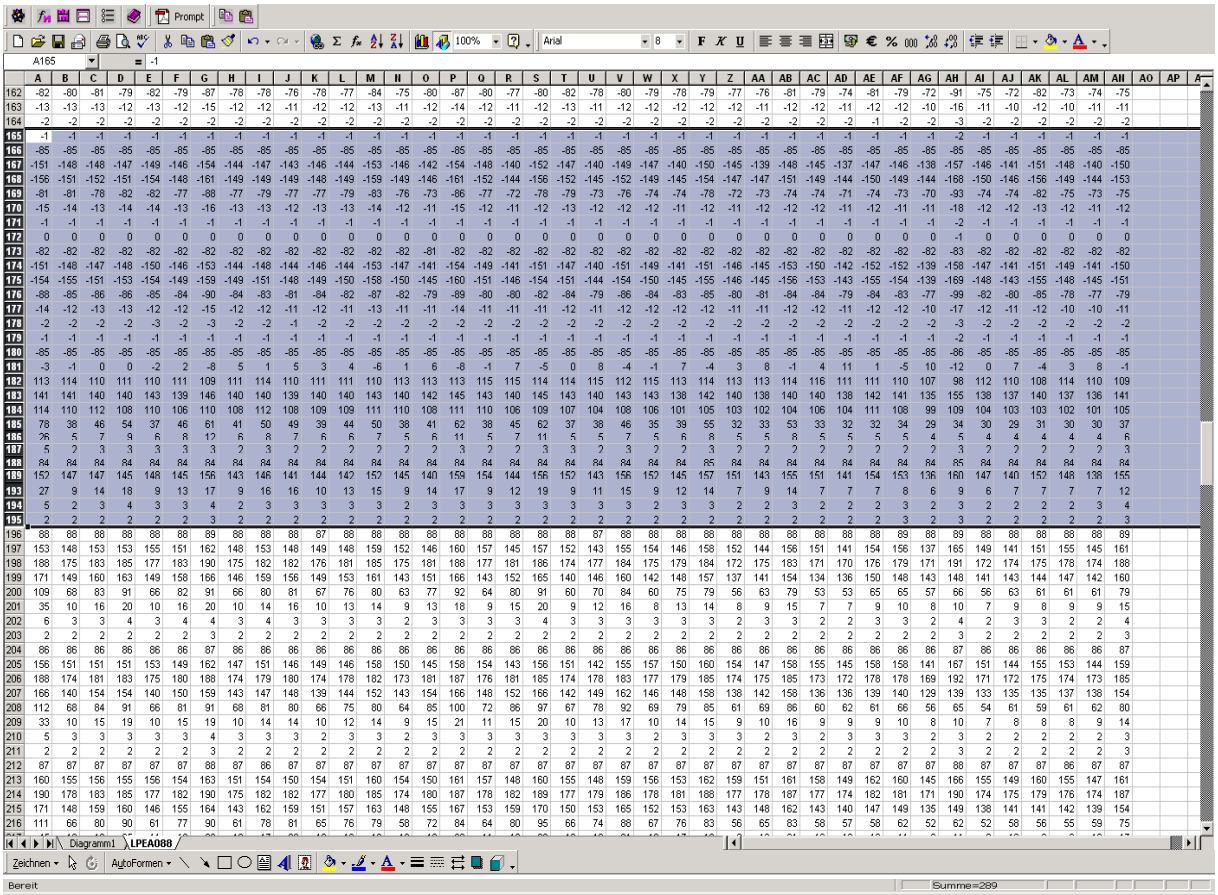


Fig5: Marking up to 255 rows is possible for a line plot of transposed data.

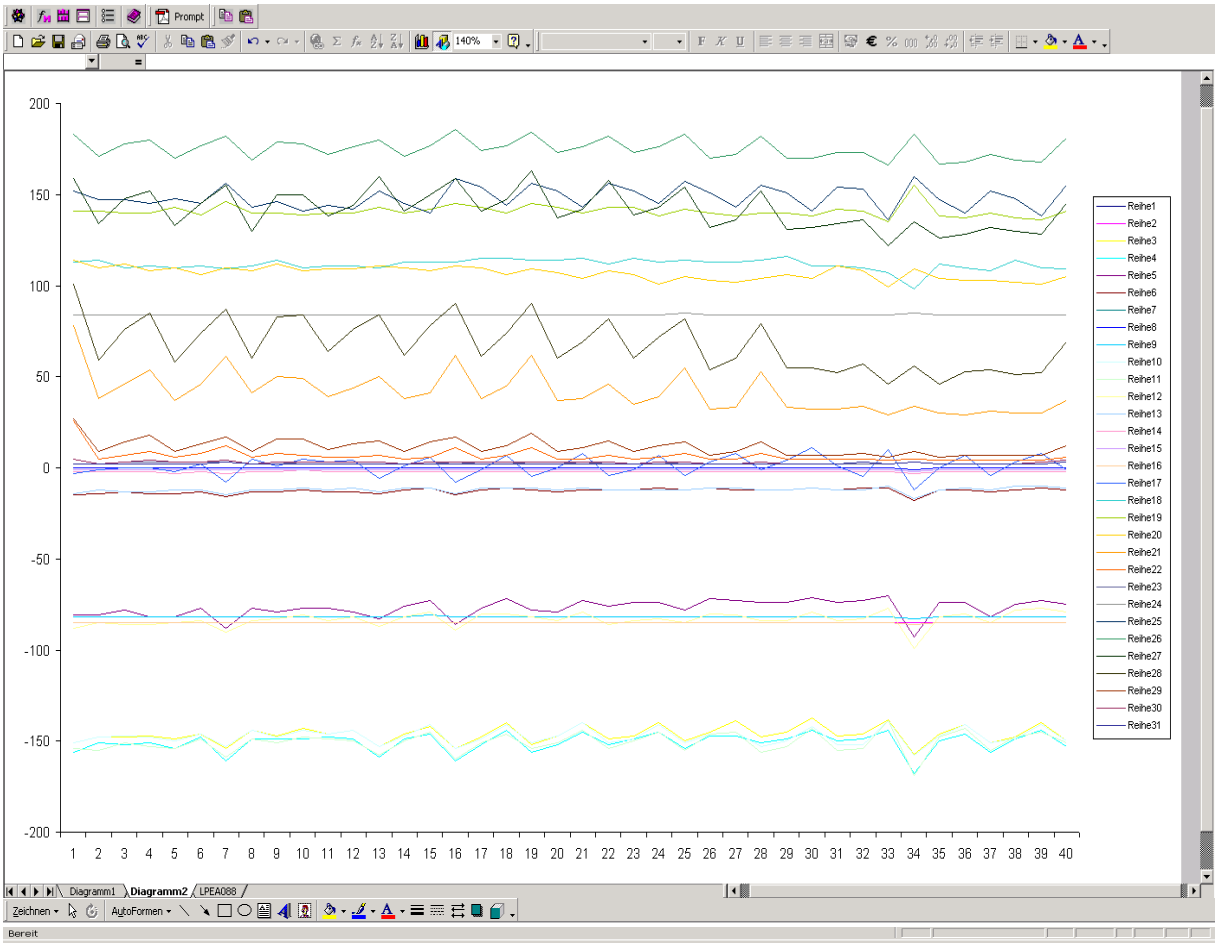


Fig.6: Each line now stands for a record, the horizontal axis now gives the leaf number.

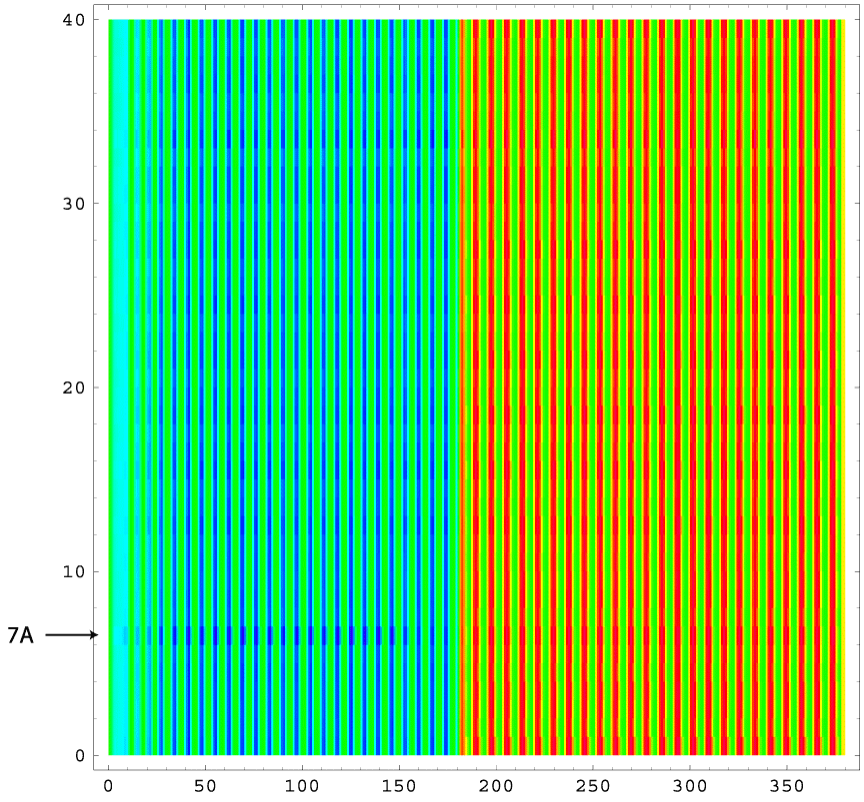


Fig.7: LPEA of Fig.4, plotted with Mathematica®