Using Bespoke Matlab Software for the Collection and Processing of Dynalog Files from the Varian Millennium 120 MLC system following delivery of Intensity Modulated Fields.

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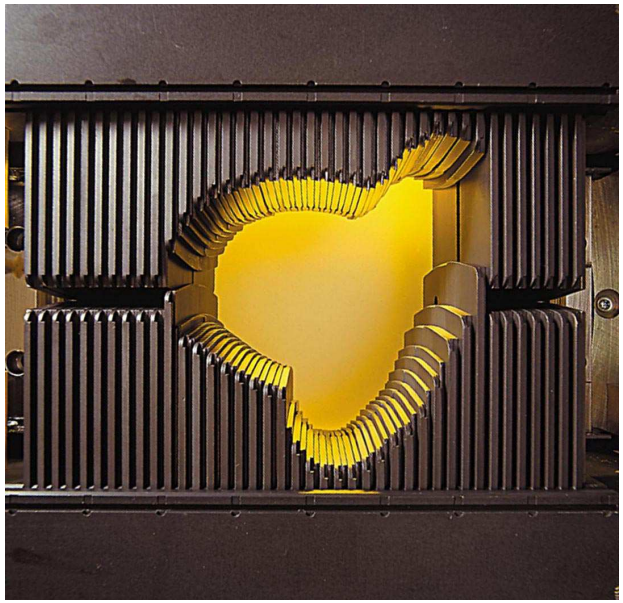
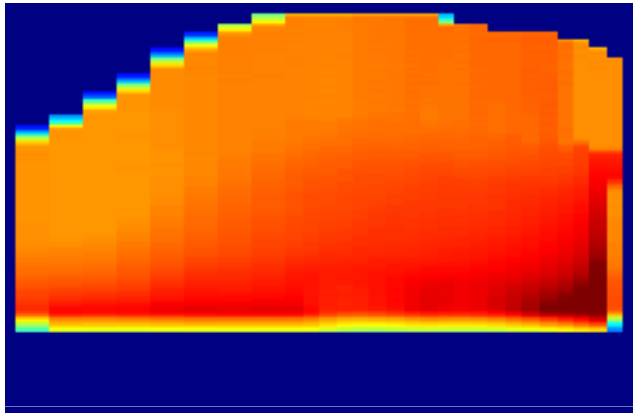
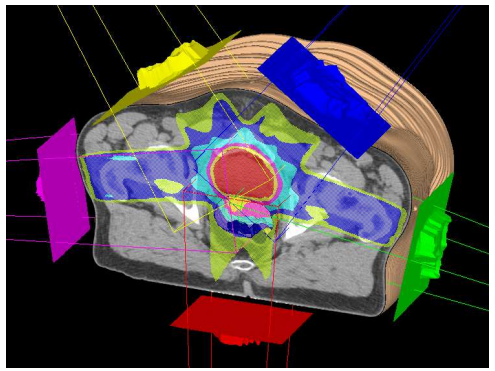
Summary:

- Introduction to the MLC system
- Description of the log files
- Aims of the use of the Dynalog system
- Method:
  - Description of Graphical User Interface (GUI)
  - Data used
- Results
- Questions

IMRT:







1. 120 Tungsten Leaves used to shape radiation fluence.
2. Fluence combines with other beams to produce required dose distribution

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IMRT current testing:

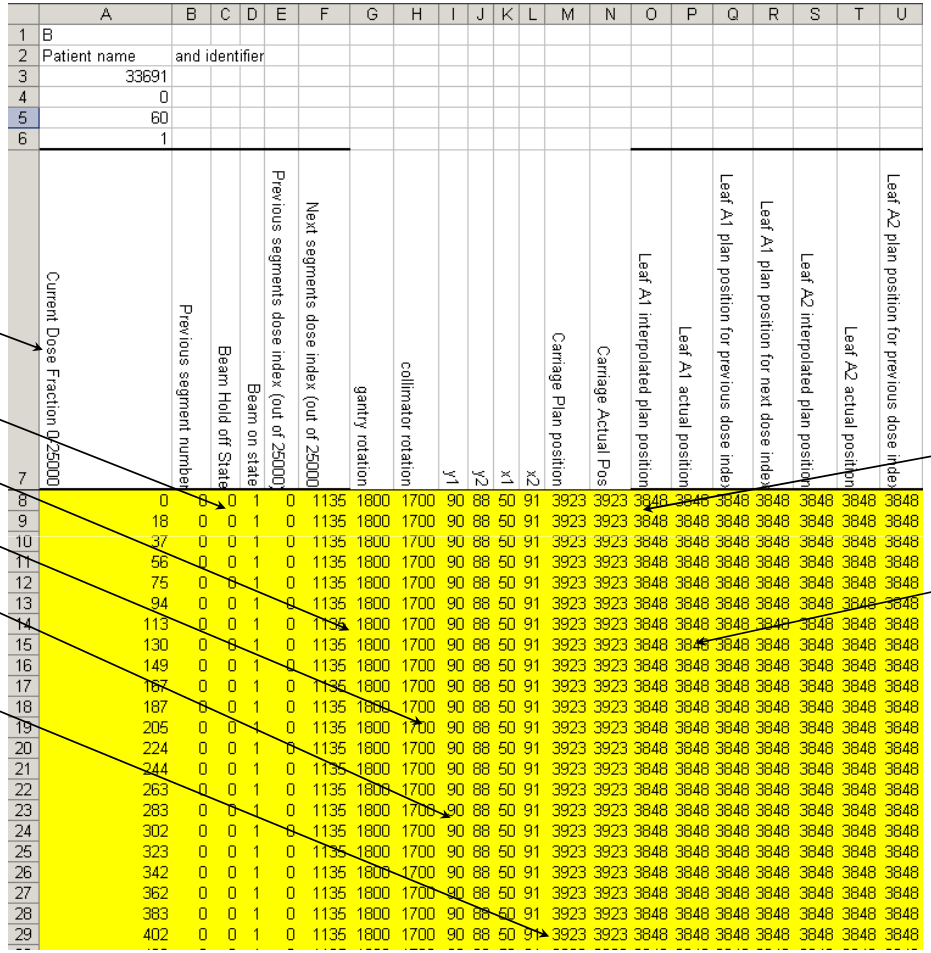
- Current QA is performed
  - Pre-treatment verification of fields
    - Checks of leaf motion
    - Transfer of data
    - General deliverability of plan
  - Second check software
  - Frequent imaging
- What is missed?
  - Verification of correct delivery when the plan is delivered to the patient on a daily basis.

What are Dynalogs:

- These are produced by the MLC controller on Varian Linacs for all IMRT deliveries.
- They log data every 50ms on various parameters
- They indicate performance of the MLC which gives information on the performance of the Linac

File Format:

- Current Dose Fraction
- Beam state
- Gantry angle
- Collimator angle
- Jaw positions
- Carriage positions



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	B																				
2	Patient name	and identifier																			
3	33691																				
4	0																				
5	60																				
6	1																				
7	Current Dose Fraction (/25000)	Previous segment number	Beam Hold off State	Beam on state	Previous segments dose index (out of 25000)	Next segments dose index (out of 25000)	gantry rotation	collimator rotation	y1	y2	x1	x2	Carriage Plan position	Carriage Actual Pos	Leaf A1 interpolated plan position	Leaf A1 actual position	Leaf A1 plan position for previous dose index	Leaf A1 plan position for next dose index	Leaf A2 interpolated plan position	Leaf A2 actual position	Leaf A2 plan position for previous dose index
8		0	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
9		18	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
10		37	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
11		56	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
12		75	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
13		94	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
14		113	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
15		130	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
16		149	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
17		167	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
18		187	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
19		205	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
20		224	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
21		244	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
22		263	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
23		283	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
24		302	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
25		323	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
26		342	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
27		362	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
28		383	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848
29		402	0	1	0	1135	1800	1700	90	88	50	91	3923	3923	3848	3848	3848	3848	3848	3848	3848

- Leaf plan position
- Leaf actual position

Described in Varian's "Dynalog File Viewer: Reference Guide"

Dynalogs:

- Commercial products currently exist to process Dynalog files.
  - Varian: Dynalog File Viewer
    - Limited functionality but suitable for customer acceptance
  - Doselab: FractionCHECK
    - Not free but does look very good

- These files can also be interrogated cheaply using MATLAB.

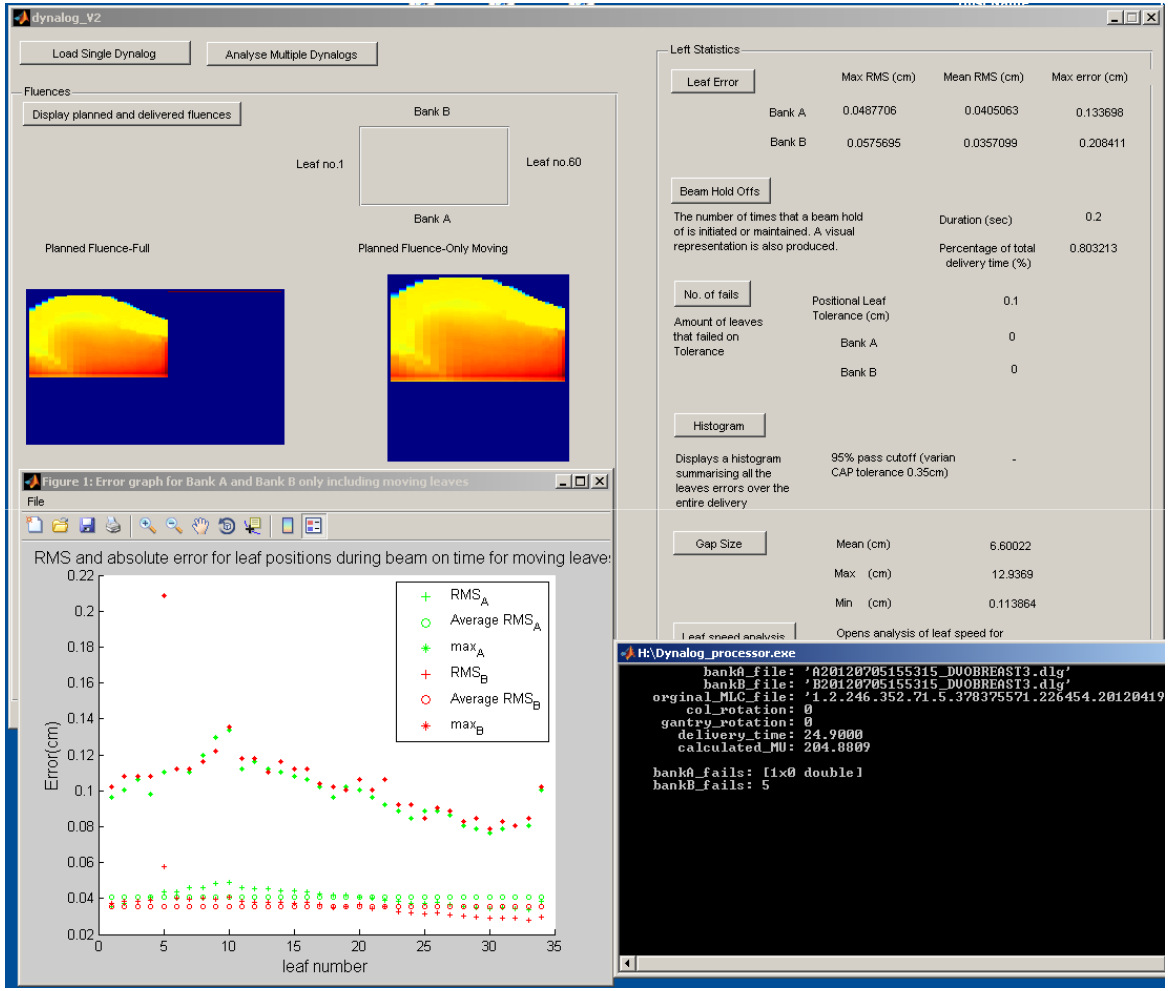
Aims of this work:

- To develop a lost cost Matlab program to analyse MLC performance during IMRT delivery.

  –Tested by

  – Comparing QA results to Dynalog results.

Bespoke Matlab GUI for Dynalogs:



- Individual file pair GUI
- Processes
  - Leaf Speed
  - Leaf RMS error
  - Time for beam holds
  - Histogram of errors
  - Gap size
  - Fluences

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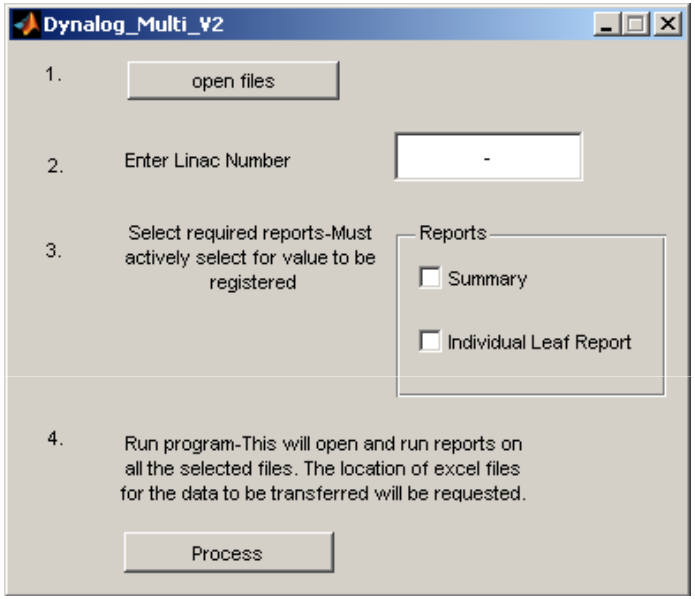
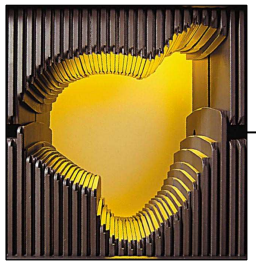
Bespoke Matlab GUI for Dynalogs:



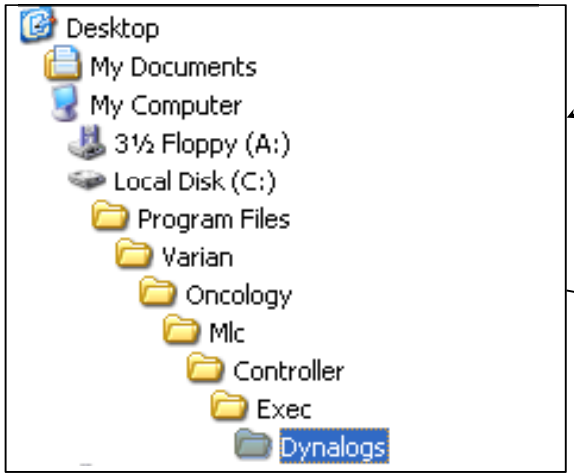
- Multi file pair GUI

  Exports reports to excel

Data Collection:

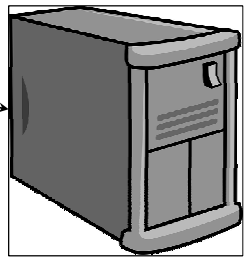


MLC movements are logged and stored on the treatment console



Each linacs data is moved to a single location-

RT server



Dynalogs are retrievable from the treatment console. Either manually or automatically.
Delete after transfer

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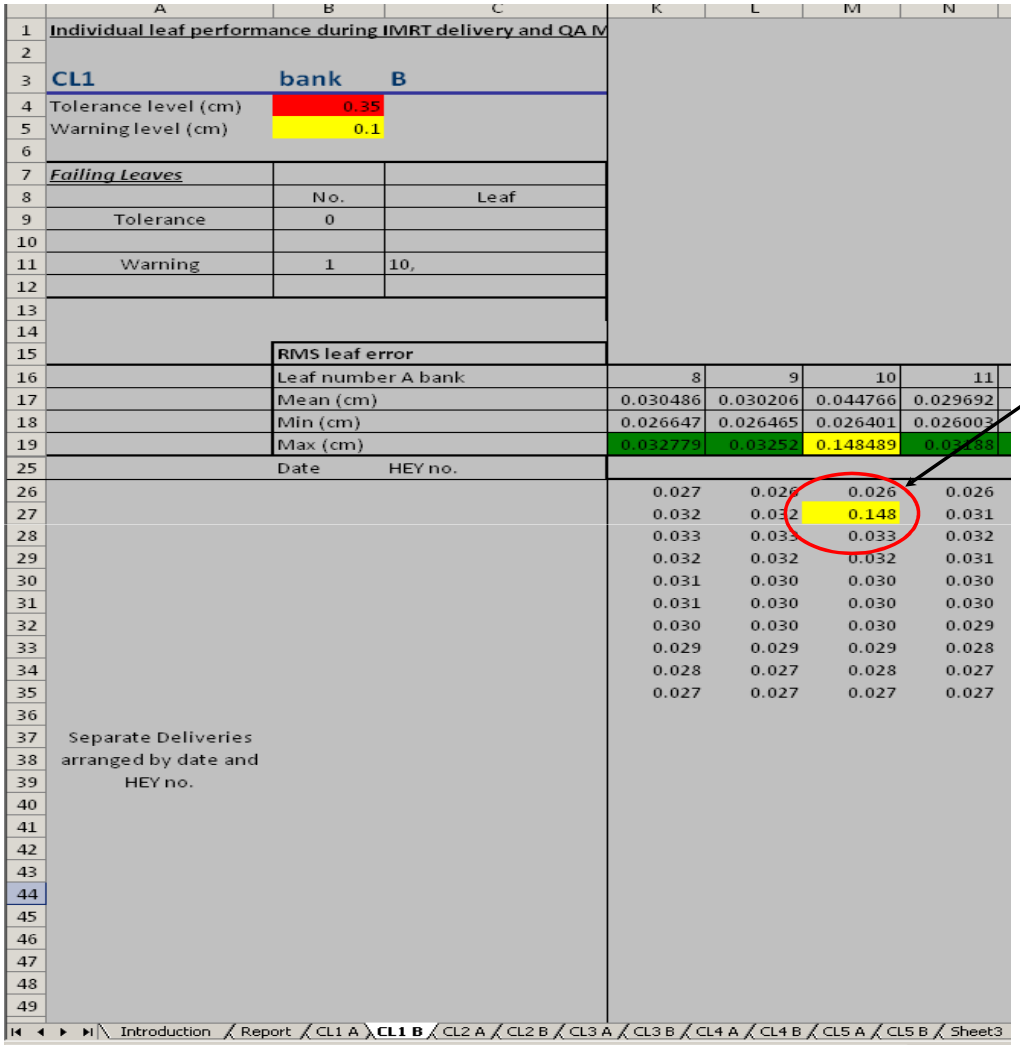
Dynalogs:

- Files can then be analysed from one location
  - On a PC with MCR (Matlab Compiler Runtime) environment installed.
- Separated according to Linac
- Organised according to patient identifying number
- Can be reviewed at chosen intervals

Excel spreadsheet for handling data:



	A	B	C	K	L	M	N
1	Individual leaf performance during IMRT delivery and QA M						
2							
3	CL1	bank	B				
4	Tolerance level (cm)	0.35					
5	Warning level (cm)	0.1					
6							
7	*Failing Leaves*						
8		No.	Leaf				
9	Tolerance	0					
10							
11	Warning	1	10,				
12							
13							
14							
15		RMS leaf error					
16		Leaf number A bank		8	9	10	11
17		Mean (cm)		0.030486	0.030206	0.044766	0.029692
18		Min (cm)		0.026647	0.026465	0.026401	0.026003
19		Max (cm)		0.032779	0.03252	0.148489	0.03188
25		Date	HEY no.				
26				0.027	0.026	0.026	0.026
27				0.032	0.032	0.148	0.031
28				0.033	0.033	0.033	0.032
29				0.032	0.032	0.032	0.031
30				0.031	0.030	0.030	0.030
31				0.031	0.030	0.030	0.030
32				0.030	0.030	0.030	0.029
33				0.029	0.029	0.029	0.028
34				0.028	0.027	0.028	0.027
35				0.027	0.027	0.027	0.027
36							
37	Separate Deliveries						
38	arranged by date and						
39	HEY no.						
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							

Introduction | Report | CL1 A | CL1 B | CL2 A | CL2 B | CL3 A | CL3 B | CL4 A | CL4 B | CL5 A | CL5 B | Sheet3

Warning!!

Excel spreadsheet for handling data:

- Report generated automatically
  - Summarises all machines checked
  - Highlights Linacs that data was not processed for

Quality Control: MLC Performance Monthly Review

Date: 30/08/2012 Processed By:

Leaf Performance

Linac	Bank	Warning no.	Out of Tol. no.	Highlighted Leaves		Does data exist for this?
CL1	A	0	0	Warning		
				Failing		No
	B	1	0	Warning	10,	
				Failing		Yes
CL2	A	0	0	Warning		
				Failing		No
	B	0	0	Warning		
				Failing		No
CL3	A	0	0	Warning		
				Failing		No
	B	0	0	Warning		
				Failing		No
CL4	A	0	0	Warning		
				Failing		No
	B	0	0	Warning		
				Failing		No
CL5	A	0	0	Warning		
				Failing		No
	B	0	0	Warning		
				Failing		No

Comments

Measured By _____ On _____

Reviewed By _____ On _____

Failing leaf identified in report

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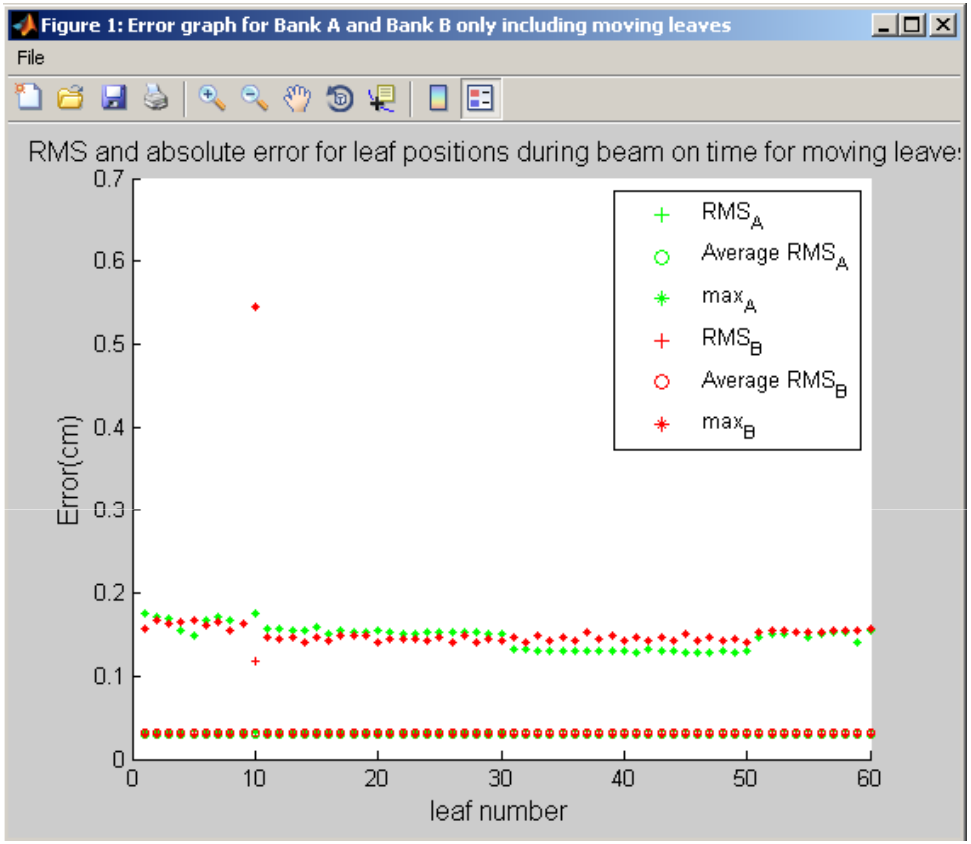

Leaf error displayed graphically in the single file viewer module of the GUI. The example shows bank B leaf 10 failing which was identifiable from its maximum error.

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Conclusions:

•This work shows that a low cost “home made” approach to the collection and processing of dynalog files can be fruitful. The free information obtainable from the collection of dynalog files can provide good fraction by fraction assessment of MLC performance via an automated process with no extra machine time required for QA.

Future Work:

•Firstly, run a monthly report on the performance of the MLC.

•Secondly, compare results from Dynamic breast fields to our currently used step and shoot IMRT method.

Acknowledgements:

Thank you to Dr Michael Hughes, (Department of Medical Physics & Clinical Engineering, Oxford University Hospitals NHS Trust) for providing parts of the code.

Code available at

> http://mike-hughes.org/medphys/dynalog.html

Hull's Oncology Information Systems team for setting up the transfer of these files

and to Jenny Marsden & Prof Andy Beavis for their supervision

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The End: