

Computerised image quality measurements

Nicholas Keat

ImPACT

St George's Hospital, London

Why do we need it?

- It is possible to perform QC measurements using tools on scanner console
 - ROI to give mean CT number and SD
 - Distance measurement tools for variety of tests
- As the number of images increases, this becomes impractical



Why do we need it?

- Repeatability and consistency is important, particularly when comparing results
 - Do all scanner tools give the same result?
 - Are the ROIs the same size and in the same position?
 - Results can't be queried if there is a problem
 - Range of testing limited by tools available

Benefits

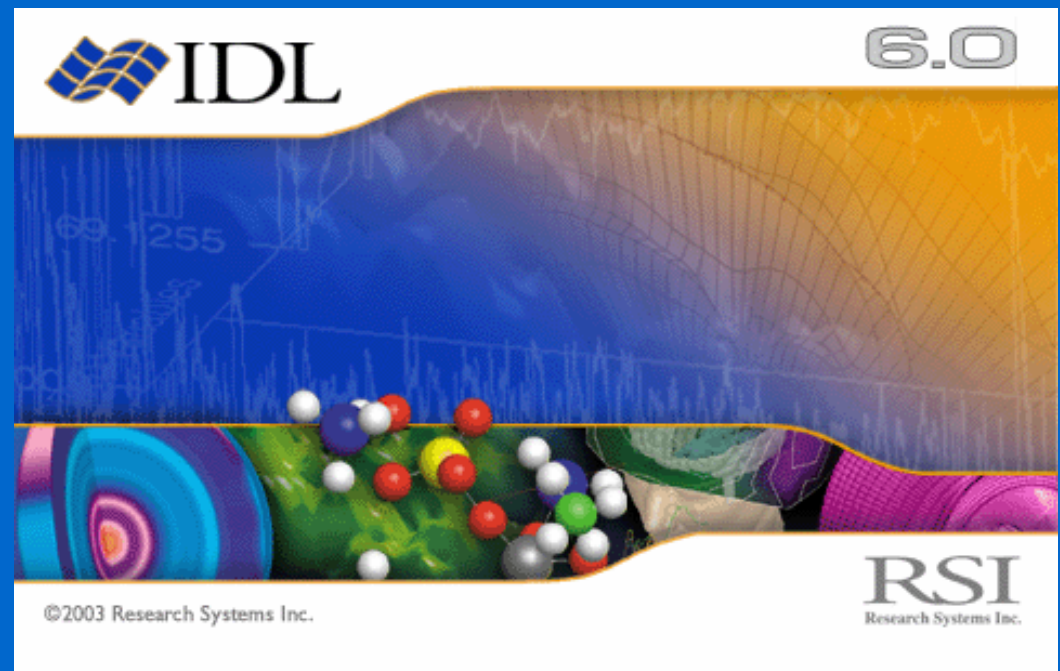
- Automation
 - Can run same analysis on many images at once
- Repeatability
 - Results can be queried
 - Data can be explored to assess anomalies
- Output in adaptable format
 - Can output summary information, e.g. MTF50, MTF10 or more full data e.g. entire MTF curve

Disadvantages

- Costs of development software
- Development costs
- Support / bug fixes
- Not commercial standard software
 - Incompatibilities with some images or situations
 - Crashes not uncommon – have to be aware of shortcomings

Evolution of IQ measurements at ImPACT

- IMPARS – old Ramtek Unix system, used reformatted images
- IMPASS – Sparc (Unix) system, used reformatted images, but could read DICOM images
 - Had to manually type results into excel etc manually!
- Current system, programmed in IDL on Windows PCs (www.rsinc.com)



Benefits of DICOM

- Compatibility
 - Previously had to take manufacturers' image format and write a 'conversion' program to a common format that is used by the analysis system
 - IDL is able to read DICOM files natively, so no conversion necessary

Transfer of images

- Used to have to have appropriate tape / MOD etc drive to read each archive format
- DICOM network transfers (Storage SCU) eliminate need for extra hardware
- CD-R is now often the easiest transfer option



How the current system works

- Images from assessment are put in directory on PC
- Images are indexed to get scan details
 - kV, mA, slice, z-pos, patient name, date etc
- Selector program used to browse and pick images for analysis
- List of image files sent to separate analysis routines
- Results output to .csv file (to be read into Excel)

IQ parameters analysed

- CT number and standard deviation
- Image uniformity
- Noise power spectrum
- Spatial resolution
 - Edge and point spread functions
- Axial z-sensitivity
- Helical z-sensitivity

- Plus image browser, low contrast phantom scoring, basic 3d viewer, various R&D tools

Image Selector

DICOM File Selector (I:\IMAGES2\ASSESSMENTS\PHILIPSMX8000IDTEXTRARES\)







File Edit Analyse Help

Noise Diff Noise NPS Uniformity Resolution Summed Res Wire Res Res Hor Ax Z Sens Sum Ax Z Sens Hel Z Sens Hel Z Full

Change Dir Update dcmintf Osiris DICOM Dump Browse LCD 3D NoisePlus

Date	Patient	Manuf.	Scanner	Patient	Study	Series	Images
04/12/03	impact^test	Philips	Mx8000 IDT	impact^test	3576	002644	0080
				impact^test	3576	002645	0080
				impact^test	3576	002647	0080
				impact^test	3576	002648	0028
				impact^test	3576	002649	0016
				impact^test	3576	002650	0080
				impact^test	3576	102634	0080
				impact^test	3576	102635	0080
				impact^test	3576	102636	0010
				impact^test	3576	102637	0080
				impact^test	3576	102638	0080
				impact^test	3576	102639	0080

Stud	Series	Im#	Acq	kV	mA	t	Slice	Mat.	Z Posn	SFOV	RFOV	Kernel
3576	102637	001	000	120	150	2000	0.75	1024	111.3	250	250	E
3576	102637	002	000	120	150	2000	0.75	1024	112.1	250	250	E
3576	102637	003	000	120	150	2000	0.75	1024	112.8	250	250	E
3576	102637	004	000	120	150	2000	0.75	1024	113.6	250	250	E
3576	102637	005	000	120	150	2000	0.75	1024	111.3	250	250	E
3576	102637	006	000	120	150	2000	0.75	1024	112.1	250	250	E
3576	102637	007	000	120	150	2000	0.75	1024	112.8	250	250	E
3576	102637	008	000	120	150	2000	0.75	1024	113.6	250	250	E
3576	102637	009	000	120	150	2000	0.75	1024	111.3	250	250	E
3576	102637	010	000	120	150	2000	0.75	1024	112.1	250	250	E
3576	102637	011	000	120	150	2000	0.75	1024	112.8	250	250	E
3576	102637	012	000	120	150	2000	0.75	1024	113.6	250	250	E

Status: 1 images selected, last is I:\IMAGES2\ASSESSMENTS\PHILIPSMX8000IDTEXTRARES\S35760\S1026370\IM00090

Image viewer



System output

The screenshot shows a Microsoft Excel window titled 'Microsoft Excel - noise.csv'. The spreadsheet contains data from a CSV file. The columns are labeled A through P, and the rows are numbered 1 through 23. The data includes patient information (Filename, Patient, Study, Series, Acq) and noise statistics (Image, kV, mA, Time, Thick, Kernel, SFOV, RFOV, Z Pos, CT Num, St Dev).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Filename	Patient	Study	Series	Acq	Image	kV	mA	Time	Thick	Kernel	SFOV	RFOV	Z Pos	CT Num	St Dev
2	F:\IMAGES	NOISE BODY	837	2	11	41	120	135	600	10	STANDARD	380	380	2.5	-0.368	26.44
3	F:\IMAGES	NOISE BODY	837	2	11	42	120	135	600	10	STANDARD	380	380	-7.5	1.112	27.82
4	F:\IMAGES	NOISE BODY	837	2	12	43	120	135	600	10	STANDARD	380	380	2.5	1.219	25.96
5	F:\IMAGES	NOISE BODY	837	2	12	44	120	135	600	10	STANDARD	380	380	-7.5	1.920	26.72
6	F:\IMAGES	NOISE BODY	837	2	13	45	120	135	600	10	STANDARD	380	380	2.5	0.946	27.87
7	F:\IMAGES	NOISE BODY	837	2	13	46	120	135	600	10	STANDARD	380	380	-7.5	1.587	26.66
8	F:\IMAGES	NOISE BODY	837	2	14	47	120	135	600	10	STANDARD	380	380	2.5	2.019	26.53
9	F:\IMAGES	NOISE BODY	837	2	14	48	120	135	600	10	STANDARD	380	380	-7.5	1.637	25.45
10	F:\IMAGES	NOISE BODY	837	2	15	49	120	135	600	10	STANDARD	380	380	2.5	1.076	26.06
11	F:\IMAGES	NOISE BODY	837	2	15	50	120	135	600	10	STANDARD	380	380	-7.5	3.100	28.07
12	F:\IMAGES	NOISE BODY	837	2	16	51	120	135	600	10	STANDARD	380	380	2.5	1.254	25.63
13	F:\IMAGES	NOISE BODY	837	2	16	52	120	135	600	10	STANDARD	380	380	-7.5	0.856	26.54
14	F:\IMAGES	NOISE BODY	837	2	17	53	120	135	600	10	STANDARD	380	380	2.5	1.953	26.07
15	F:\IMAGES	NOISE BODY	837	2	17	54	120	135	600	10	STANDARD	380	380	-7.5	1.825	26.60
16	F:\IMAGES	NOISE BODY	837	2	18	55	120	135	600	10	STANDARD	380	380	2.5	1.811	25.01
17	F:\IMAGES	NOISE BODY	837	2	18	56	120	135	600	10	STANDARD	380	380	-7.5	2.061	26.95
18	F:\IMAGES	NOISE BODY	837	2	19	57	120	135	600	10	STANDARD	380	380	2.5	0.560	28.02
19	F:\IMAGES	NOISE BODY	837	2	19	58	120	135	600	10	STANDARD	380	380	-7.5	3.971	25.78
20	F:\IMAGES	NOISE BODY	837	2	20	59	120	135	600	10	STANDARD	380	380	2.5	1.047	25.86
21	F:\IMAGES	NOISE BODY	837	2	20	60	120	135	600	10	STANDARD	380	380	-7.5	1.284	26.31
22																
23																

Future development

- More analysis!
 - General ROIs
 - Modular analysis routines (plug in format)
- Better error handling
- Flexible output templates
- Make analysis less CT specific for other modalities
 - The imaging world is not just 512 x 512!
- Better structure and commenting

