(HU) profiles in relevant positions and histograms of a 2*2 cm area in the tongue region inside the dental arc were compared with and without (NO-MAR) the use of the MAR algorithm.

Results: For MAR acquisitions, CT numbers were identical in any slices without artifact compare to the NO-MAR in both cases. For the case 1, the edge of the implants are better define (sharper gradient of HU) and the repartition of HU in central region is mean (m): 46.4, std: 60.8, range: [-134,295] in the MAR images compare to the baseline m: 26.6, std: 91.1, [-301,203]. Concerning the case 2, a better definition of the interface with the metal implant was obtained with MAR too. HU values in the central area were m: -77.1, std: 740.8, [-1000,2296] in the NO MAR image and (m: 189.7, std: 209.1, [-715,832] in the MAR one. In the slice presenting the more artifacts, these results are m: 95.1, std: 642.9, [-1000,1780] and m: 10.8, std: 258.4, [-733,546] in the NO Mar and MAR images respectively. Outside of the dental arc, profile results in a fictive parotid area are m: -88.1, std: 485.3, [-1000,1212] for the NO MAR image and m: -6.6, std: 126.7, [-587,406] with the algorithm use.

Conclusions: Uses of MAR algorithm improve image quality in these very difficult case were many metal implants are near one from the others. Compare to baseline, a big improvement is found when high density material is present in the image, especially inside the area encountered by the artifacts where accuracy HU is increase.

EP-1533

ICE-Studio - An Interactive visual research tool for image analysis

T. Nyholm[1], M. Berglund[1], P. Brynolfsson[1], J. Jonsson[1]
[1]*Umeå University, Department of Radiation Sciences, Umeå, Sweden*

Purpose/Objective: Research projects involving image analysis are frequent in the modern radiotherapy environment, where we often have access to CT, MR and PET data for our patients. There is a lack of tools that are both complete but still flexible enough to facilitate advanced research. Therefore it is common that the image analysis is performed in a mixture between commercial softwares and for example Matlab.

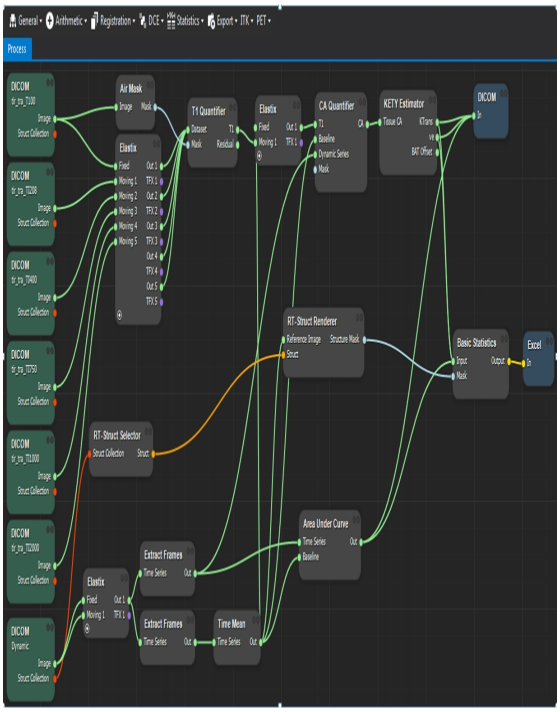
The aim of this project was to develop an open software that combines the flexibility of for example Matlab, with an easy to use user interface for setup of analysis workflows. The workflows can then be applied to large cohorts of patients.

Materials and Methods: ICE-Studio is built in the .NET framework. The interface is constructed in C#, but certain features use C/C++, such as the registration module[1]. Actions are represented by boxes, which can be connected to form a workflow. Images are imported through a database, or from folders containing DICOM files, and results can be exported as DICOM files, Excel files or meta image format files (mhd/raw). Analysis algorithms have been implemented in MATLAB and verified to give the same results. The code is structured so that implementing a new action box for a new analysis step is easy. The developer has to define how many inputs and outputs are needed and what object types they are (e.g. images, masks, RTSTRUCTs, etc), and finally the algorithm to produce the output data given the input data.

1 'Elastix: A toolbox for intensity-based medical image registration' IEEE Trans. Med. Imaging 29(1), 196–205 (2010)

Results: The software has action boxes to set up a complete Dynamic contrast-enhanced MRI (DCE-MRI) workflow, rigid and non-rigid registrations, arithmetic operations, statistical filters, creating air masks, creating masks from RTSTRUCT files, smoothing filters, edge enhancing filters and texture information. More filters are easily imported from the ITK[2] filter libraries.

2 'ITK: enabling reproducible research and open science.' Frontiers in neuroinformatics 8(13) 1-13 (2014)



Conclusions: The software simplifies the setup and design of analysis workflows, which can be applied to individual or sets of patients in the database.

The software will be freely accessible from www.radiotherapy.se.

EP-1534

Quantitation of PET/CT registration

A. Seoane[1], N. Anducas Santiago[1]
[1]*Hospital Universitario Vall d'Hebron, Physics Dpt, Barcelona, Spain*

Purpose/Objective: During last decade, Positron Emission Tomography (PET) has been widely included into radiotherapy treatment planning due to the possibility of incorporating metabolic information when defining the Gross Tumour Volume (GTV) in the computed tomography (CT). The proper definition of GTV is directly related to the accuracy of the registration of the different imaging techniques used in the treatment planning process.

As part of the quality control of PET/CT registration, IAEA Publication 1393 recommends a visual analysis of the centres of the spheres of IEC Body Phantom for PET and CT images. Instead of this subjective method, we propose a new way to quantify the registration error based on the delimitation of the spheres on the CT and PET. Our study compared the results for two different types of software.

Materials and Methods: A Siemens Biograph64 mCT was used to acquire CT and PET images of the IEC Body Phantom. Following EANM guidelines for tumour PET imaging, we filled 6 spheres (of diameters from 1.0 to 3.7 cm) with ^{18}F concentration of approximately 20 kBq/ml and the body compartment with a concentration ten times lower. A whole body protocol was applied with matrix size of 512x512 (CT) and 200x200 (PET), leading to a pixel size of 1.52 mm (CT) and 4.07 mm (PET). Plane spacing was set to 1 mm.

After the acquisition, PET/CT images were exported to the software MultiModality WorkStation VE52A (MMWS, Siemens) and, independently, to the treatment planning system Eclipse v11 (Varian).

The spheres in the CT image were manually contoured in Eclipse. For PET images, the delimitation of the spheres was performed -in both MMWS and Eclipse- with an automatic tool, creating a volume containing pixels with standardized uptake value (SUV) higher than a threshold of 20% SUVmax.

The centre of the spheres was determined by creating a treatment plan in Eclipse for each sphere. The isocentre is automatically placed in the centre of mass of the sphere.

To calculate the registration error, the differences of Cartesian coordinates between the centre of mass of the CT-spheres and the corresponding PET-spheres were measured for both PET images contouring systems.

Results: Mean (range) registration errors for all the spheres are summarized in the following table:

	LEFT(+) & RIGHT(-)	ANTERIOR(-) & POSTERIOR(+)	CRANIO(+) & CAUDAL(-)
CT- Eclipse (mm)	0,55 (0.20 – 0.90)	0,47 (-0.30 – 0.90)	0,72 (0.30 – 1.20)
CT- MMWS (mm)	-0,08 (-0.50 – 0.20)	-0,03 (-0.40 – 0.30)	0,85 (0.40 – 1.20)

Conclusions: As it is shown in the previous table, results were below 1 mm in all directions. The main difference was obtained in cranio-caudal direction for both PET images contouring systems.

MMWS showed a better agreement between CT and PET images than Eclipse, for left-right and antero-posterior direction. Although both kind of software are suitable for contouring, results suggest that MMWS could be a better tool for contouring in PET.

EP-1535

Planning quality Variations : for IMRT lung cancer based on treatment plan database

J.H. Koo[1], M.G. Yoon[1], W.K. Chung[2], D.W. Kim[2]
[1]*Korea University, Department of Bio-Convergence Engineering, Seoul, Korea Republic of*
[2]*Kyunghee University Hospital at Gangdong, Department of Radiation Oncology, Seoul, Korea Republic of*

Purpose/Objective: There have been consistent studies on QA with development of RT technique, but there is a weakness of current QA that there are always some possibilities of accident if human-induced factors were not controlled. And among human factors, planning error is critical to patients. So we focused on plan quality as a main treatment quality determination factor and analyzed 45 lung cancer IMRT plans to verify fluctuation of plan quality as a preliminary study of developing planning QA algorithm.

Materials and Methods: In purpose of verifying plan quality deviations, we collected 45 solitary lung cancer IMRT plans. Volume, length and width were considered to compare cancer sizes of solitary cancers. Cancer position determining factors were vertical distance from lung apex and median line. Organs in or near thoracic cavity, lung, heart, liver, esophagus, cord, and bronchus, were selected as OARs. PTV-OAR surface to surface vertical distance was measured to analyze correlation of distance and irradiation. CVI,HI,EUD,V10,V20,$D_{min,}D_{max}$were used to compare and RT plans. Average normalization point was 94.5%.

Results: Among total 45 cases, esophagus, cord, heart, bronchus, and liver were separated from PTV in 24, 43, 21, 13, 40 plans and respectively. EUD showed a slightly downward tendency as CI decrease and distance increase in most OARs. But heart had a singular value and liver showed a lightly growing tendency when distance from PTV was above 15cm. In PTV-OAR overlapped cases, Bronchus and heart EUD had a growing tendency as an increase in overlapped volume. But it was hard to find a general tendency in PTV-overlapped cord and liver cases because overlapped cases were not enough. Esophagus also barely showed tendency. HI value was 0.19±0.12 and CVI ranged from 0.8 to 1, mostly between 0.9 and 1(0.92±0.04).

	V10	V20	EUD
Lung (PTV)	29.7 ± 20.1	15.0 ± 16.1	8.4 ± 5.4
Lung	6.1 ± 8.6	1.2 ± 2.4	2.5 ± 2.0
Esophagus	25.0 ± 20.4	12.2 ± 16.5	6.7 ± 5.4
Cord	14.5 ± 18.1	5.4 ± 10.2	3.6 ± 3.3
Liver	2.0 ± 6.1	0.8 ± 2.8	0.8 ± 1.7
Heart	20.7 ± 25.8	9.9 ± 16.0	5.3 ± 5.5
Bronchus	36.3 ± 33.8	23.0 ± 32.2	10.8 ± 12.1

Conclusions: In absence of standard quality assurance system for planning, substantial discrepancy of plan quality for similar cases is inevitable. By establishing quantitative references for treatment planning, such as algorithms, deviations of treatment quality from planner to planner could be reduced considerably. Considering that specimens of this study were from one department, which means not many people were involved in making decision, imbalance of treatment result for same patient would be much more severe if many departments were involved. For these reasons, research on planning QA is needed and planning QA may result in upward leveling of radiation treatment.

EP-1536

X-ray pulse time matters in CBCT imaging

R.S. Thing[1], C. Brink[1]
[1]*Institute of Clinical Research, University of Southern Denmark, Odense, Denmark*

Purpose/Objective: The Elekta XVI CBCT system provides a range of different combinations of x-ray pulse current (mA) and time (ms) when acquiring a CBCT scan. For a range of nominal scan doses (mAs), there is more than one combination of x-ray pulse current and time which provides