

Mirada – Case Study

VentureFest, July 2015

Synopsis of Mirada Medical

- Founded in 1999 as a spin-out from the University of Oxford
 - University had 10% equity...
- Headquartered at the OCFI, Oxford
- Mirada USA based in Denver, CO
- Our technology is used at 1000s of global sites in RT, NM & Radiology
- OEM partners include: Varian, GE, McKesson, Siemens, Vital Images



... so how did it happen, and where is it going?

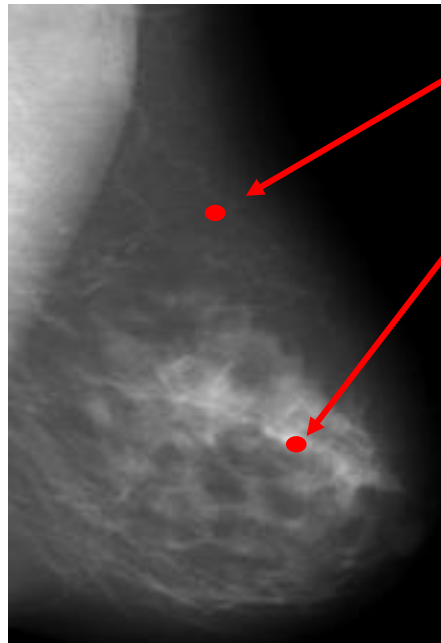


The roller coaster ride

- Birth** as  and growing pains: 1999-2003
- Adolescence** as  and a growth spurt: 2003-2005
- Becoming serious** as  Molecular Imaging 2005-2008
- Renaissance** following MBO as  2008- now

1999: JMB's Lab had developed two technologies

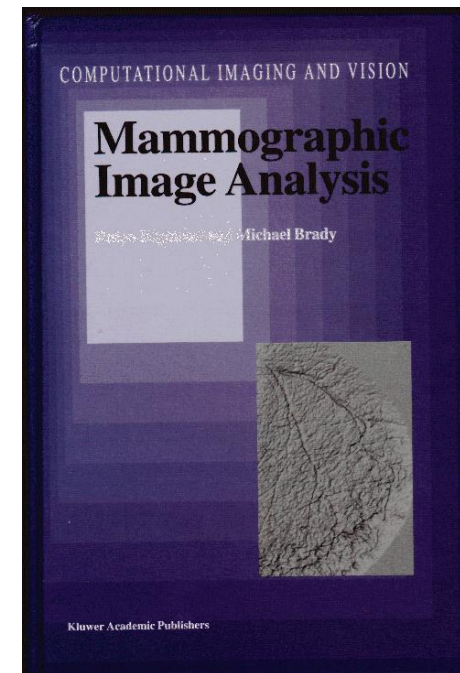
1. Quantitative mammography



At this pixel, 5.8cm of fat; 0.2cm of dense tissue

At this one, 3.6cm fat, 2.4cm of dense tissue

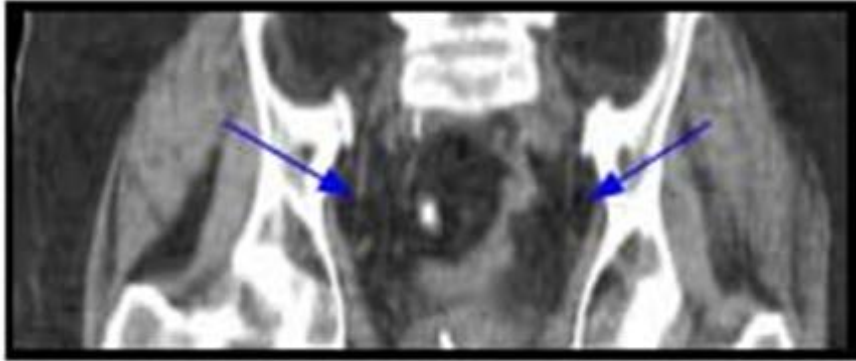
SMF
Standard
Mammogram Form



- Mammographic image analysis was woefully qualitative
- ... anyway, we'd published a book so it had to be a commercial success



2: Image fusion - most often, one image isn't enough

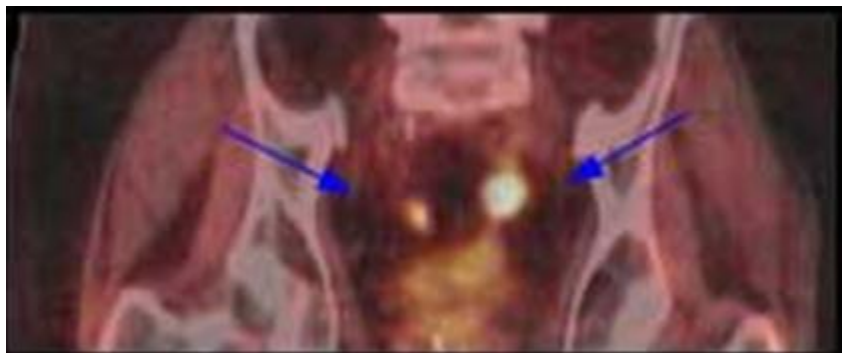


CT scan of region of interest is very high precision picture of the anatomy; but the clinically significant information is often ambiguous or just not available...

Fusion7D



PET scan of whole body reveals possible tumour; but is so low resolution it is hard to be sure where it is



The combination of the information from CT and PET provides the definitive diagnosis (in this case)

This requires the non-rigid alignment of the two images & a presentation of the salient information that they jointly provide

2001: Product launch = make or break



65,000 delegates:
conference &
trade show



Suits are worn

Opening day, Sunday morning
Sunday afternoon

Post-RSNA

- Ice SMF
- Bet everything on **Fusion7D**



May 2002

SMF 1 workstations
Standard Mammogram Form

Fusion7D : 5 workstations

We weren't just lucky (though we were pretty lucky)

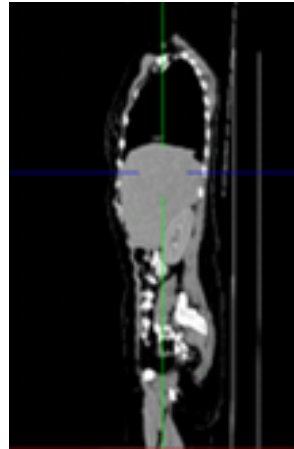
2001: The emergence of *combined* PET-CT → need for fusion



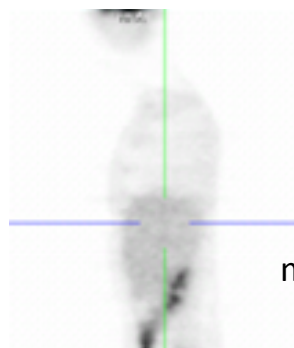
CT



PET



Anatomy,
quantitative



metabolism

Initially, many hospitals had a PET machine and a CT machine; but wanted the capability of PET-CT → “software fusion” of the separate images



Integrated PET – CT machine

- PET inventors were founders of CTI molecular imaging
- CTI & Siemens co-developed the PET-CT machine
- Siemens the primary customer and distributor

2003: Which of the 5 fates await Mirada?

- **Bankruptcy**: most likely – lumpy revenues, high burn rate
- **IPO**: fantasy, especially after the dotcom boom
- **Private, megacompany**: dream on
- **Staggering along from crisis to crisis**: most likely
- **A fairy godmother appears**: ... and buys the company

The New York Times

Business Day

COMPANY NEWS

**COMPANY NEWS; CTI MOLECULAR
ACQUIRES MIRADA FOR \$22 MILLION**

Published: August 20, 2003

Life under new owners

- Software development to support CTI's PET-CT products
 - **Scenium** - accurate assessment and quantification of dementia and other neurological diseases
 - **Research Workbench** – an image analysis system for preclinical applications (for the CTI *Inveon* scanner)
- Rapid growth & a new CEO
 - 40 → 75 people in Oxford + 50 in Chicago
 - Chris Behrenbruch made CEO, aged 28



Scenium



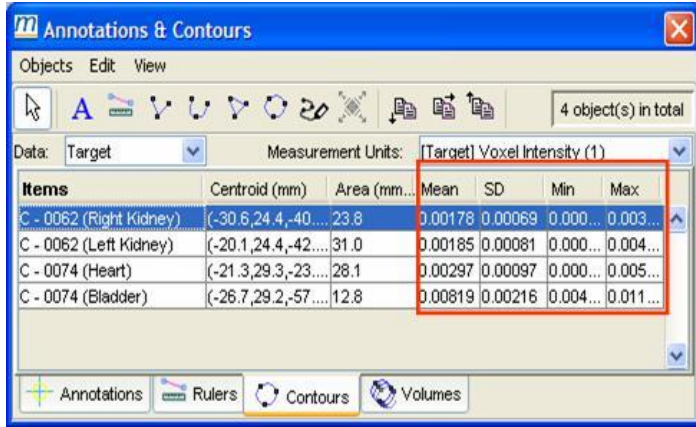
- *Scenium* enables clinicians to compare patients' brain scans to standard normal scans
- This can highlight differences in uptake
- Multiple anatomical regions are highlighted for quick assessment of an image
- Enables quantitative comparison with other images

Diagnostic imaging, radiology

CTI Mirada wins FDA approval to market its Scenium PET scan analysis software

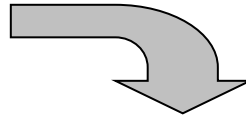
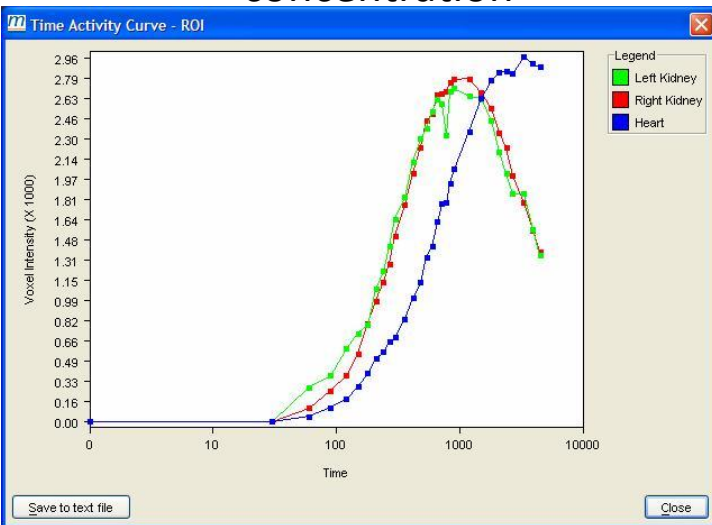
18 January 2005

Research Workbench

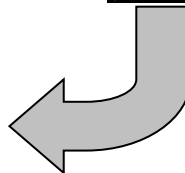


Segmentation tool

Time activity curves of drug concentration



Organs of interest segmented



Life under new owners

- Software development to support CTI's PET-CT products
 - *Scenium* - accurate assessment and quantification of dementia and other neurological diseases
 - *Research Workbench* – an image analysis system for preclinical applications (for the CTI Image Center)

THE WALL STREET JOURNAL.

EUROPE TECHNOLOGY

Siemens to Pay About \$1 Billion To Buy CTI Molecular Imaging

By MATTHEW KARNITSCHNIG and RACHEL GRAHAM Staff Reporters of THE WALL STREET JOURNAL

Updated March 21, 2005 12:01 a.m. ET

- Continuation of “3rd party” software development



SIEMENS



MCKESSON

SECTRA



...

Introduction

- Siemens Molecular Imaging continues the Oxford office!
- Development of *Scenium* (and other software products) continues as part of the *syngo.via* software platform

MI Neurology

- Neurology Reading
- Neurology Analysis
- Database Comparison
- Ratio Analysis
- Print

Findings Navigator

Name	Value	Source

View Annotations Tools Help



Workflow

- Functional to Template
- Results:Analysis**

Tools

Color Maps

NM

Normalization Region

Occipital lobe (AAL) Show

Striatum | Regions of Interest | Key Images

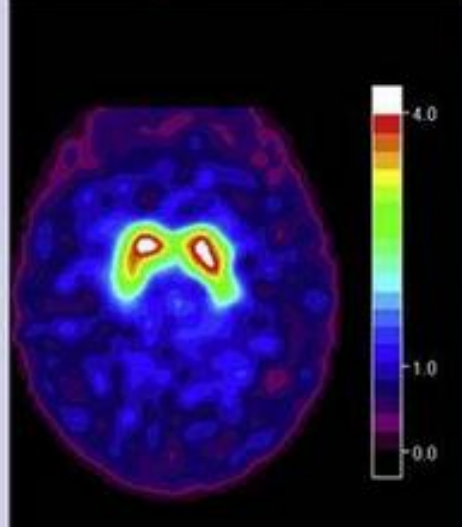
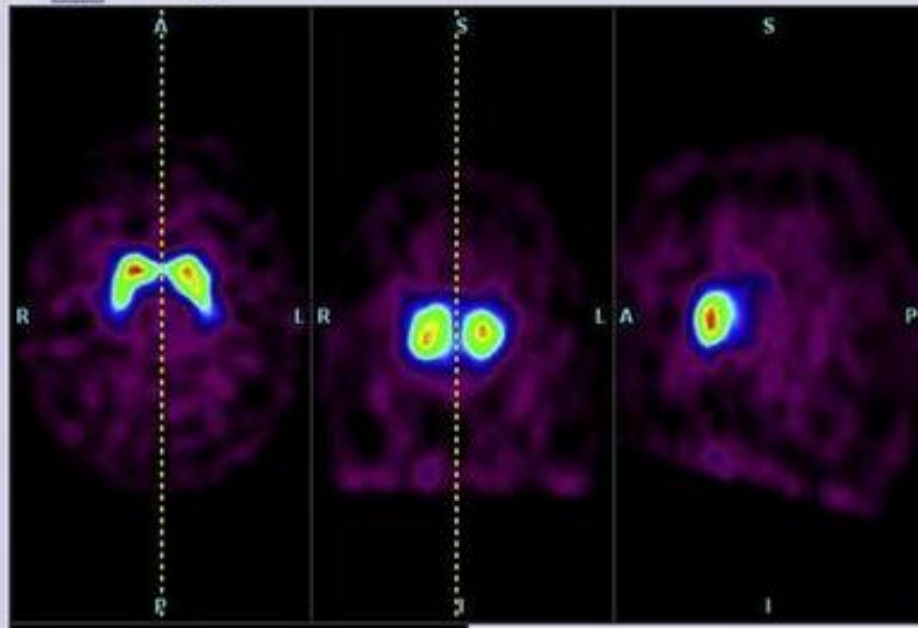
Name
Striatum (L)
Striatum (R)

Values displayed are (-)

- Link Left and Right ROI for Editing
- Display Striatum Box

Edit ROIs

Tools for editing and deleting ROIs.



Normalization Region Occipital lobe (AAL)

Ratio to Normaliza...	Right	Left
Caudate	3.94	3.70
Putamen	3.70	3.71
Striatum	3.75	3.71

Asymmetry Meas...	Value
Caudate Asymmetry	0.06
Putamen Asymmetry	0.00
Striatum Asymmetry	0.01
Putamen(L) / Cau...	1.00
Putamen(R) / Cau...	0.94

Bottom toolbar with various navigation and analysis tools.

Introduction

- Siemens Molecular Imaging continues the Oxford office!
- Development of *Scenium* (and other software products) continues as part of the *syngo.via* software platform
- 3rd party business increasingly languishes



Hugh Bettesworth
CEO, Mirada Medical

April 2009

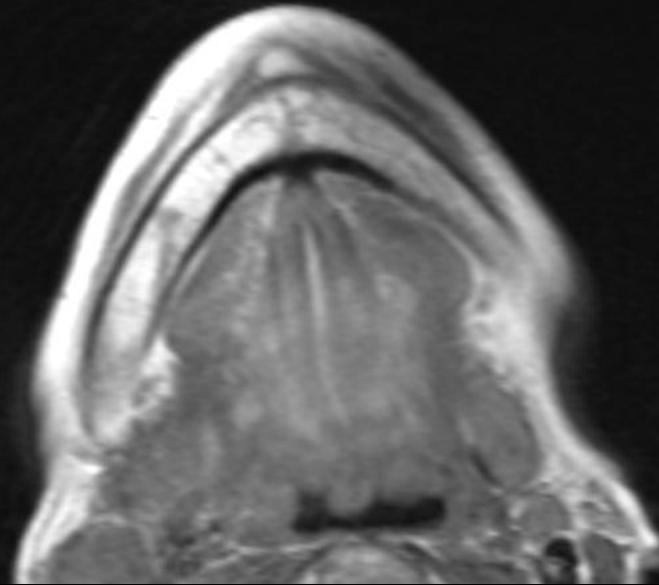
ALBION VENTURES

Albion ventures Invests £1.5 million in an MBO of Mirada Medical from Siemens

Introduction

-  was overwhelmingly a technology play
 - Our deformable registration was streets ahead of the competition in terms of accuracy, speed, general applicability. We were **the** fusion company
- In 2009, at the launch of  our competitive edge in deformable registration had partly eroded and no longer differentiated us
- Move up the food chain and stress applications – in cancer
- We are **the** cancer image analysis company

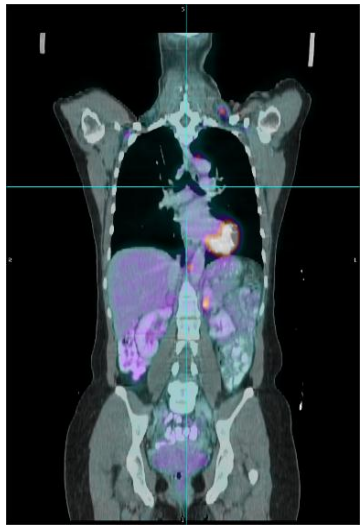
Image fusion



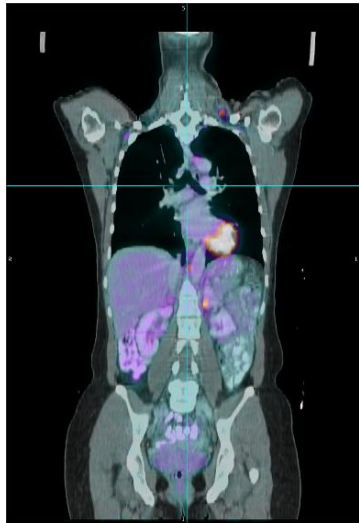
Late breaking news: Mirada Medical + Alliance Medical have contract to supply all PET-CT analysis for NHS

15 years after the launch of Mirada Solutions...

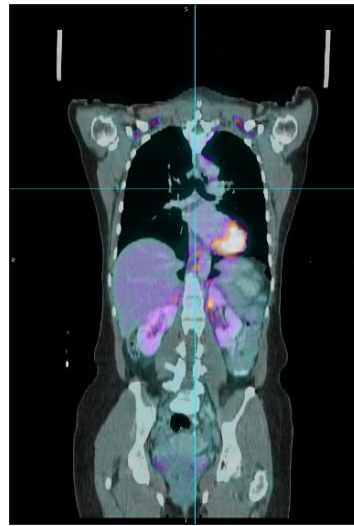
During Therapy: Quantitative Tumour Tracking



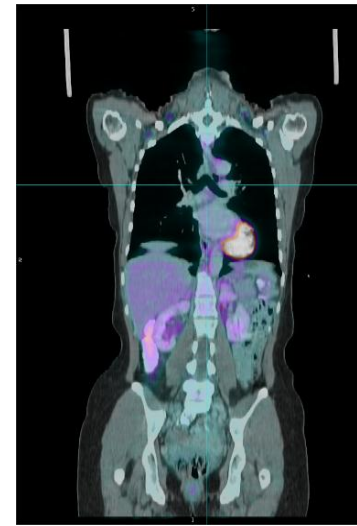
Apr 07



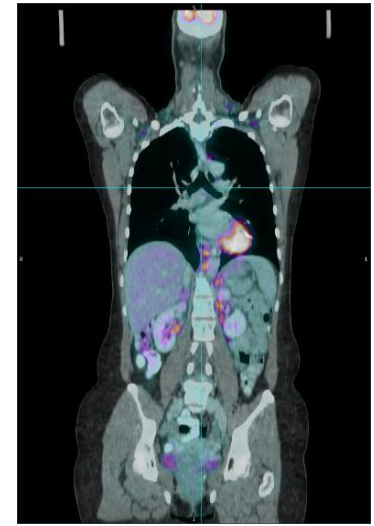
Oct 07



Apr 08



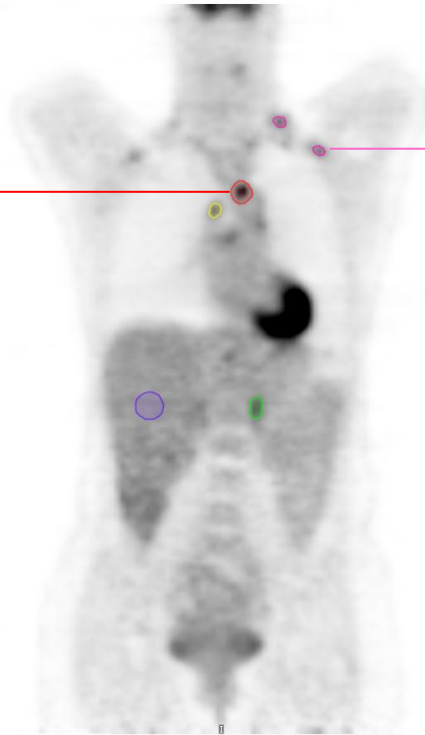
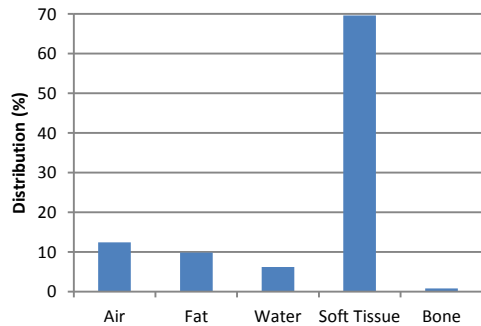
May 09



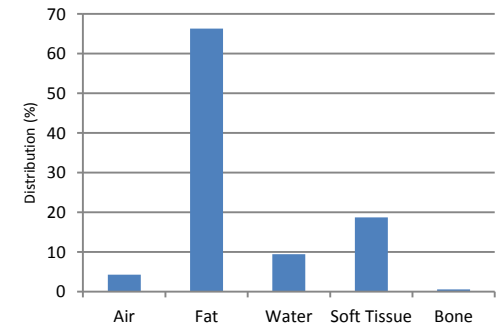
Nov 09

Quantitative Tumor Tracking

SUV Mean (g/ml)	3.7
SUV Max (g/ml)	9.5
SUV Peak (g/ml)	7.3
Metabolic Volume (cm ³)	11.4
SUV Max Ratio to Liver	3.5

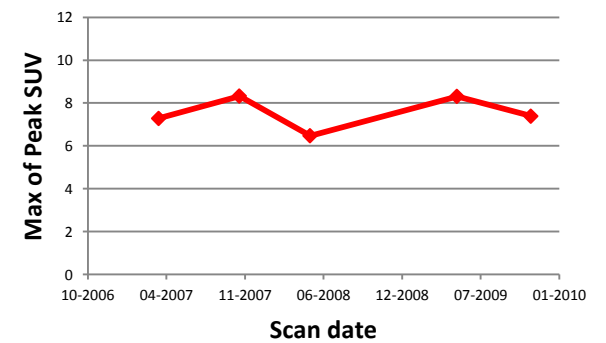
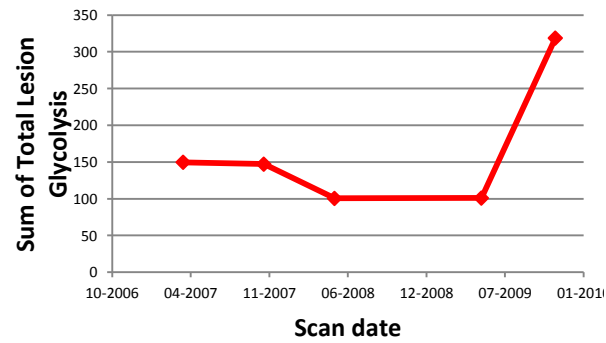
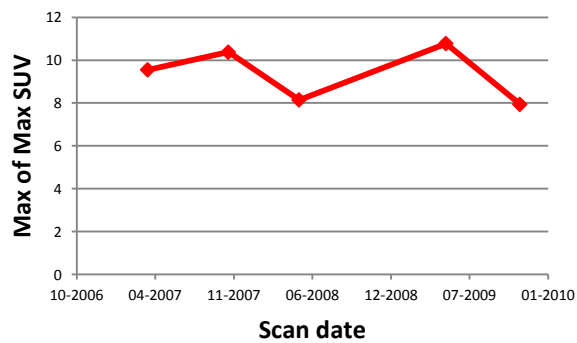
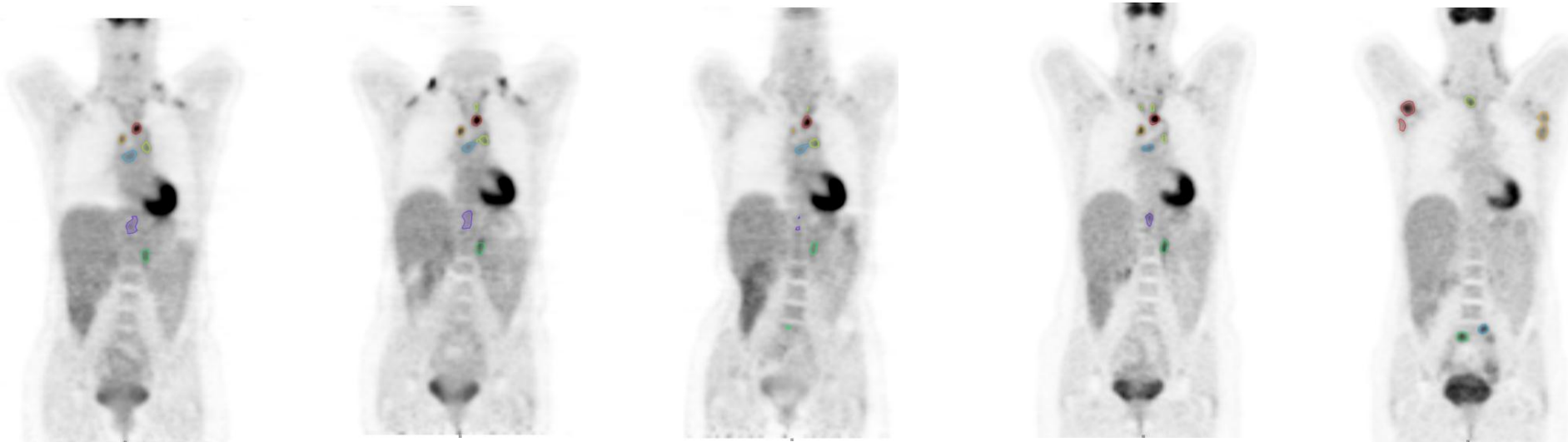


3.4	SUV Mean (g/ml)
6.4	SUV Max (g/ml)
5.4	SUV Peak (g/ml)
13.5	Metabolic Volume (cm ³)
2.4	SUV Max Ratio to Liver



Efficient, quantitative tools for standardized and reproducible results

During Therapy: Quantitative Tumour Tracking



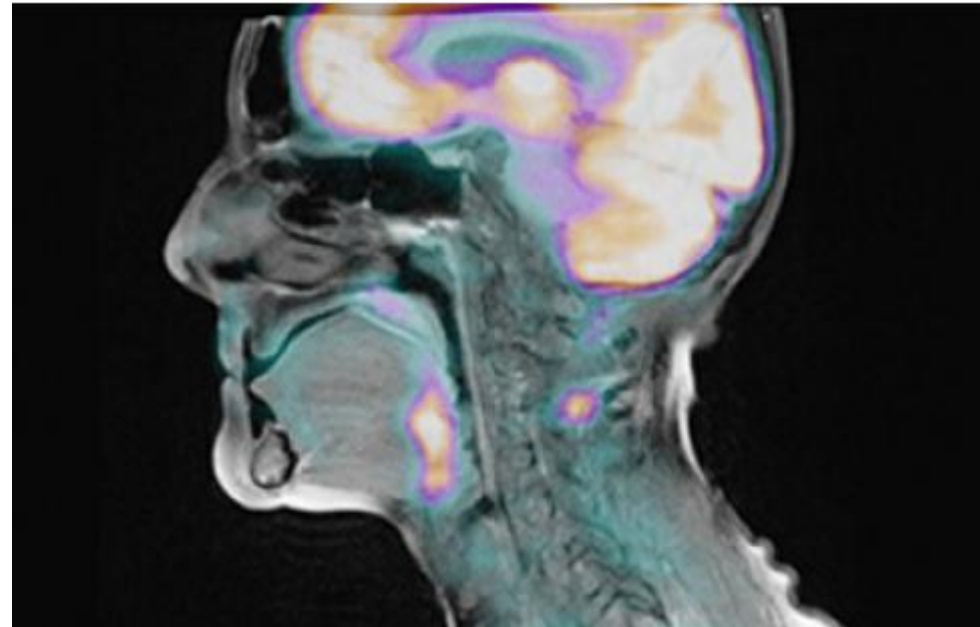
PET-MRI fusion



Philips Ingenuity TF PET-MR system



Siemens Biograph mMR

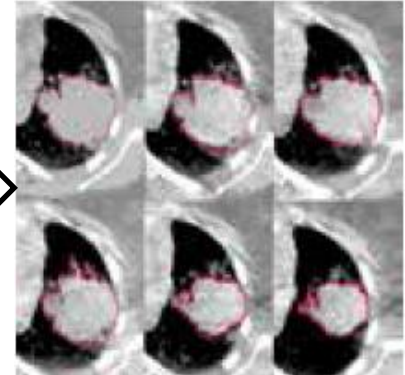
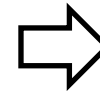
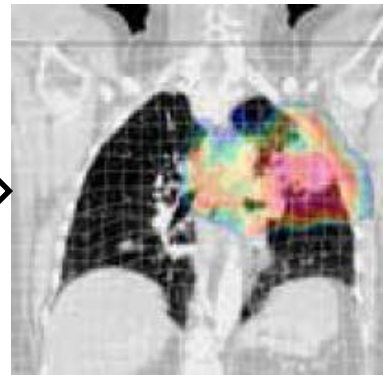
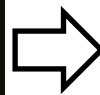
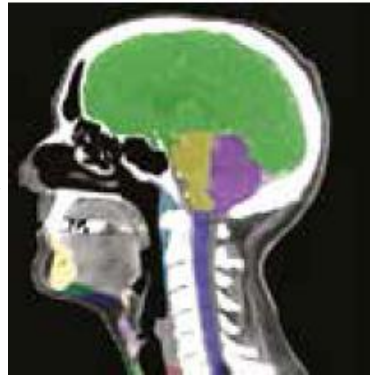
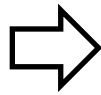
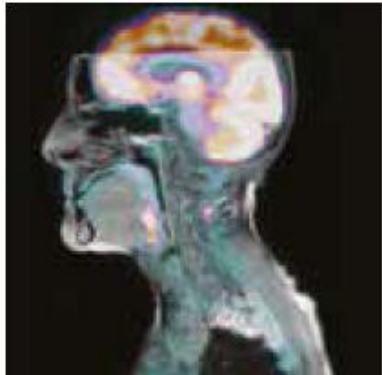


PET-CT-MRI image fusion

Mirada's deformable registration equates to research state-of-the-art, and works almost always

... here we go again!!

Radiation Therapy



Multi-modal fusion

Multi-atlas
contouring

Dose deformation and
summation

Adaptive re-planning

Typically PET, CT
and/or any of 10
MRI sequences

Typically from a
previous case or
atlas of cases
warped onto this
patient

Reduce the uncertainty
around re-treatment
decisions by aligning
previous dose volumes
to current planning CT

rapidly warp the
previous structures
to the new planning
volume

This session and any
relevant, previous
images

XD Nuclear Medicine – Automatic Renal Segmentation

Mirada Medical - NMx Advanced 4.0 - Evaluation license, not for clinical use

File Edit View Image Regions Tools Window Help

Control Modes

Image Tools

Renal

- Motion Correction
- ROIs
- Renogram
- Vascular Analysis
- GFR & ERPF Analysis
- Deconvolution Analysis
- Rutland-Patlak Analysis

Regions

- Left Kidney
- Right Kidney
- Left Background
- Right Background
- Bladder
- Aorta

Key Images

Patient: Renal 16 - 2 Phase, LASIX - Kaiser 702320232 Sex: M DoB: <blank>
Study: Renal 14/07/2014 Accession #: <blank>

0mm 100mm 200mm 300mm 400mm

00:00 41:00

14:52: Multiple warnings have been detected.

Prospects

- PET-CT finally taking off in the UK – based on Mirada’s software
- PET-MRI seems set to reprise the history of PET-CT
 - There are some big players, for example in the Netherlands
- The new Nuclear Medicine product is generating huge interest
- Huge potential of combining Mirada’s capabilities for measuring response to therapy with biotech companies: software-enhanced pharmaceuticals
- ... competition is increasing, necessitating agility and investment
- Mirada needs investment to fuel its ambitions for growth
<http://www.mirada-medical.com/>

Why do I start companies?

1. Frustration of dealing with large companies, particularly in medical image analysis, *and particularly in the UK*
 - 99% of Mirada's sales are in the USA, as are Matakina's
2. I can't help it (Guidance, Mirada Solutions, Mirada Medical, Matakina, ...)
3. Secure the kids' futures yet live with academic poverty
4. The dream of a swimming pool in Provence ..

