EC COST B21
Physiological Modelling of MR Image Formation

MINUTES of 2nd MANAGEMENT COMMITTEE MEETING

VENUE
Invercarse Hotel, 371 Perth Road
Dundee – Scotland

Saturday 13th March 2004

PRESENT	
AUSTRIA	Ewald MOSER
BELGIUM	Roger DOMISSE
CZECH REPUBLIC	Monika DEZORTOVA
	Milan HAJEK
	Daniel JIRAK (invited)
CYPRUS	George GREGORIOU
DENMARK	Anders KARLSSON
	Hans STODKILDE-JIRGENSEN
FRANCE	J. DE CERTAINES (representing J. CHAMBRON),
	Said GHANDOUR (representing S. MEME)
	P. A. ELIAT (invited)
GERMANY	Jürgen REICHENBACH
	Lothar SCHAD
HUNGARY	Tamas JARDANHAZY
ITALY	Nicola CULLEDU
	Alberto SPISNI
NORWAY	Olav HARALDSETH
	Arvid LUNDERVOLD
	A. MALYSHEV (invited)
POLAND	Andrzej MATERKA
	Michal STRZELECKI
	M. KOCINSKI (invited)
SPAIN	Andres SANTOS
UNITED KINGDOM	Richard LERSKI
	Maria PETROU

EXCUSED: S. LONCARIC (HR), J. CHAMBRON (F), S. MEME (F), J. MOLNAR (H), B. CARSTOCEA (RO), A. STAICU (RO), D. DOBROTA (SK), V. MLYNARIK (SK), S. KOVACIC (SL), M. DESCO (E),

List of the Management Committee members given in Annex 1

1) **Welcome to participants:** R Lerski opened the meeting by welcoming everyone to Dundee.

2) **Adoption of the Agenda:** The Agenda was adopted.

3) **Adoption of the Minutes of Last Meeting held in Brussels (15th December 2003)**
The minutes of the last meeting held in Brussels on 15th December 2003 were accepted as a true record.

4) **Presentation of Delegates**
This was carried out during the Working Groups on 12th March.

a) 17 Countries have now signed the Memorandum of Understanding, although the status of The Netherlands is still not clear. R Lerski asked if anyone knew of any possible collaborators from The Netherlands. E Moser suggested the University of Leiden (David Norris) as a possibility.

b) R Lerski pointed out that all the COST countries that join in May are eligible and commented that Canada, for instance, could contribute if any possible collaborator was known and that the COST OFFICE is quite keen to involve Canada provided that the Canadian government will reimburse its experts participants. E Moser mentioned ICP Smith as a possible collaborator. R Lerski said that he would make contact with The Netherlands and Canada again, but also pointed out that we have to be careful not to make the group too large.

5) **Status of COST B21 Action and 6) Short Term Scientific Missions** were discussed together

Short Term Scientific Missions

The rules have changed slightly since COST B11. The minimum time for a STSM is five days – maximum one month. The purpose of these missions is so that groups can interchange to learn new techniques etc., and it is mainly for younger people (Post docs etc.). It is also important to spread the missions around the different countries and they must be relevant to the Action. R Lerski also commented that he thought it *may* be possible for someone from the committee to go on a STSM, but permission would have to be sought from the COST Office. Once the application is made, it then goes to the STSM panel of the MC for evaluation and approval. Then the proposal has to be sent to the COST Office (M Pascu) for final approval (see cost.cordis.lu). Reimbursement for the mission is made after the visit, and usually takes around one month. The Committee is urging the ESF to try to make sure the money *is* refunded within one month, but this means that all the documentation presented for a claim must be correct. The total budget for each action meetings, workshops support, etc is 70,000 Euro;the maximum amount for one STSM is 2,000 Euro, which covers travel and accommodation. R Lerski commented that M Pascu encourages members to make as many applications as possible. H Stødkilde-Jørgensen remarked that STSMs are quite important when the final project evaluation is carried out.

Possible suggestions were made:

- Jena – Vienna
- Italy – Germany or UK
- Poland – Norway
- Rennes – Prague (a young radiologist)
- Austria – Heidelberg

Dr Lerski said he would send application forms out to the sub-group.

7) Dissemination :

Publications

It was felt too early to discuss publications for the present Action. However, M Hajek proposed writing a textbook entitled "Texture Analysis for MR Imaging", which would be based on the work of COST B11 and B21. The book would take the following format:

Proposed Editors	-	M Hajek, A Materka and R Lerski
Technical Support	-	A Barclay and M Dezortova
Publishers	-	Could be in Prague.

Using MaZda would enable to add a CD Rom to the textbook.
Clarification will be sought from the COST Office as to whether or not they will pay any of the publication costs for this book. R Lerski asked for comments and whether everyone thought this was a good idea – which they did.

M Hajek carried on the discussion by explaining that he would like to prepare the textbook with many graphics and an explanation of how texture can be used in MR plus other fields of medicine. There are already 30 publications from our group, so there is already enough material to make a start, although the issue of copyright was raised. M Hajek said that 50% of the text in the publications would have to be changed and the figures modified. H Stødkilde-Jørgensen pointed out that, from the COST Committee's point of view it is a very good idea to write a book, but once the commitment is made you *have* to carry it through. M Hajek stated that negotiations have been started with a publishing company in Czech Republic and suggested that we *may* get some support from the COST Office to buy some copies, and that we could maybe also try to get sponsorship from a company.

M Hajek then asked for suggestions as to how we could organise three chapters and thought it might be an idea to make certain people responsible for certain chapters, as follows:

Chapter:

1	What is the Texture	-	A Materka
2	MaZda	-	M Strzelecki
3	Texture Features	-	J de Certaines
4	Statistical Methods	-	M Petrou
5	Influence of Resolution and Signal to Noise	-	L Schad + A Lundervold
6	Phantoms	-	D Jirak
7	Modelling	-	J de Certaines
8	Clinical Application	-	R Lerski to organise a group
9	Food Analysis	-	A Karlsson
10	Advanced Techniques of TA 3D	-	To chapter 3

Deadlines:

- Short key words or extracts of what people involved think should be in each chapter.
- Data will be summarised and a final Abstract will be compiled by Thursday 15th April. This will be a maximum of one page and will be circulated around the whole group.
- Distribution of topics of chapters – 15th May 2004
- Chapter size – approximately 30 pages each (A4 size)
- Final deadline for the manuscript for the book should be March 2005.

Website: A Santos volunteered to establish a website – COST Office will not pay for this.

8) Update on Work Plan

Working Group 1:

A presentation was given by J Reichenbach entitled "Measuring Techniques: Tissue Parameters and Physiological Data". This is attached as Annex 2.
The outline was accepted.

Working Group 2:

A Materka gave a presentation. This is attached as Annex 3.

Working Group 3:

WG3 has the objective of testing and organising clinical trials on methods and procedures arising from WG1 and WG2. It was recognised that, in this early phase of the Action, no new trials could be organised.

Results on texture analysis obtained by the Prague group during their multicentre trial highlighted the difficulty of comparing results from different machines, even when made by the same manufacturer. In the long term, this problem will need to be solved, but the discussion during the working group identified that it might be possible to look at *relative* changes in parameters that occur as a result of well defined tissue changes.

It was agreed that groups participating in WG3 would review their data and report back in due course with the results of these studies.

9) <u>Agreement of Working Group Meetings</u>

It was decided that it would be better, at present, to continue to meet as a large group rather than hold meetings of individual Working Groups. R Lerski proposed two more meetings for this year. S Voinova commented that the last one should be held before 15th November or it would come out of next year's budget. Application will be made to hold the meetings as follows:

- June 26th 2004 – Brussels
  - ⇒ Arrival Friday 25th
  - ⇒ Meeting of working Groups Saturday 26th (No MC meeting)
  - ⇒ Departure Sunday 27th
  - ⇒ Agenda to be done by J Reichenbach
  - ⇒ The focus of the meeting will be WG1 and the text book

- October 1st and 2nd 2004 – Cyprus
  - ⇒ Arrival Thursday 30th September
  - ⇒ Meeting of WGs 1st and 2nd October
  - ⇒ Meeting of Management Committee 2nd October
  - ⇒ Departure Sunday 3rd October
  - ⇒ The main focus will be to discuss the progress of WG2 and WG3

10) <u>Place and Date of Next Meeting of Management Committee</u>

2nd October 2004 in Cyprus

11) <u>AOCB</u>

A Santos announced that he has some money for a Ph.D student to go to Madrid. The interest would be in either PET, small animals or molecular imaging. He has good contacts with the hospital, so this could also be clinical.

Alison Barclay Svetlana Voinova

3 July, 2004

Annex 1

COST ACTION B21
"Physiological Modelling of MR Image Formation"
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Version: 3 July, 2004

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APPENDIX I – Working Group 1

COST B21 – 2nd MANAGEMENT COMMITTEE MEETING

Venue: Invercarse Hotel – Dundee, Scotland

Saturday 13th March 2004

Cost B21 Dundee, 12.-13.3.2004

WG I: Measuring Techniques:

Tissue Parameters and Physiological Data

Jürgen R. Reichenbach

Institut für Diagnostische und Interventionelle Radiologie
Klinikum der Friedrich-Schiller-Universität Jena
Germany

List of Systems / Techniques / Activities related to COST B21 / WG I

Name	Systems	Techniques	Activities
Ewald Moser Vienna	3T / 80 cm (Bruker) research system ^{1}H, ^{23}Na coils 2 gradient systems	BOLD venography / SWI ^{1}H-MRSI ^{23}Na-Imaging Microimaging	brain tumors / MS human cartilage (in vivo / ex vivo) skeletal muscle
Said Ghandour Strasbourg	High field animal system	Perfusion Diffusion Texture Analysis Image Processing SPECT	Mouse Models Brain WM Diseases Contrast increase Quantification Molecular Imaging
Roger Dommisse Belgium	7 T / 8 cm (SMIS)	Diffusion Perfusion BOLD MRI Contrast Studies	Animal Models (mice, birds) different pathologies brain plasticity Phantoms

List of Systems / Techniques / Activities related to COST B21 / WG I

Name	Systems	Techniques	Activities
Lothar Schad Heidelberg	1,5 T clinical system Siemens Symphony	Perfusion (ASL) Diffusion BOLD venography ^{23}Na-Imaging	Brain (Tumours)
Jürgen Reichenbach Jena	1,5 T clinical systems (Siemens Symphony, Sonata, Vision)	SWI / BOLD venography Diffusion (DWI / DTI) Perfusion ^{1}H, ^{31}P Spectroscopy	Brain (Tumours, vascular disease) Muscle
Milan Hajek Daniel Jirak Matin Burian Prague	High field system (4,7 T)	MRI / MTS, DWI, CSI dedicated spinal cord coils; sequence developments at 4.7 T; construction of phantoms	Brain (Tumours) Cell transplantation Calf Muscles Liver

List of Systems / Techniques / Activities related to COST B21 / WG I

Name	Systems	Techniques	Activities
Olav Haraldseth Christian Brekken Trondheim	High-field systems NMR spectrometers	Diffusion Tensor Imaging Method development Perfusion BOLD-fMRI (preoperative planning)	Human brain tumours Animal models rat brain tumours rat brain CNS
J.D. De Certaines P.A. Eliat J. Bezy-Wendling M. Garreau Rennes	High-field systems: 4,7 T / 40 cm (12/04) Mice PET (05) 1,5 T (GE) (3 T in project) NMR spectrometers: 500 MHz 500 MHz HR/MAS 270 MHz µMRI: 7 T vertical magnet clinical SPECT & PET	Contrast-enhanced MRI Texture Analysis (2D & 3D) Modelling Interest for: BOLD, perfusion, diffusion Physiological relevance of texture parameters (by comparison with optical microscopy & modelling	Clinical oncology (brain, liver) Animal models (liver diseases) Modelling (liver) µPET (near future)

Expression of interest to participate or contribute to WG I

Maria Petrou

Hans Stødkilde-Jørgensen

Arvid Lundervold

Jozsef Molnar

WG I: Measuring Techniques: Tissue Parameters and Physiological Data

Development and Implementation of MR sequences and/or techniques

Main Techniques

- Perfusion: first-pass methods, Arterial spin labeling (ALS)
- DWI, DTI
- BOLD-imaging: SWI, CO_2 challenge, CE-SWI
- ^{23}Na imaging

Organ(s):
Brain, (Liver)

WG I: Measuring Techniques: Tissue Parameters and Physiological Data

Development and Implementation of MR sequences and/or techniques

Perfusion: first-pass methods, Arterial spin labeling (ALS)

- Improvement of Perfusion-Modeling (A. Malyshev)
- Application of Perfusion Modelling to Perfusion Phantom (L. Schad)
  Improvement of Quantitation?
- Measurements at different sites at different field strength
- (Re-)-Analysis of acquired perfusion data (brain tumors, stroke, ...)
  in animals and humans

WG I: Measuring Techniques: Tissue Parameters and Physiological Data

Development and Implementation of MR sequences and/or techniques

BOLD-imaging: Susceptibility weighted imaging, CO_2 challenge, CE-SWI

- BOLD-Venography and Vascular Tree Modelling
  - Extraction of Blood Volume
  - Verification with Phantoms
- Susceptibility-Weighted Imaging and Exogenous Gases
- Combination with perfusion measurements, time resolved measurements
- Application in animals
- Applications in patients (brain tumors) at different field strengths combination with spectroscopy, MRSI

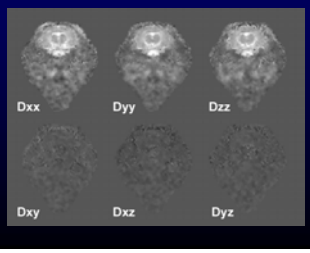
WG I: Measuring Techniques: Tissue Parameters and Physiological Data

Development and Implementation of MR sequences and/or techniques

Diffusion Weighted Imaging, Diffusion Tensor Imaging

- optimization of acquisition, minimization of tensor element variation
- diffusion spectral imaging ?? (high field machines)
- combining with other modalities --> MEG, extraction of conductivity tensor
- tractography

$$FA = \sqrt{\frac{3}{2}\frac{(\lambda_1 - \lambda_m)^2 + (\lambda_2 - \lambda_m)^2 + (\lambda_3 - \lambda_m)^2}{\lambda_1^2 + \lambda_2^2 + \lambda_3^2}}$$



WG I: Measuring Techniques: Tissue Parameters and Physiological Data

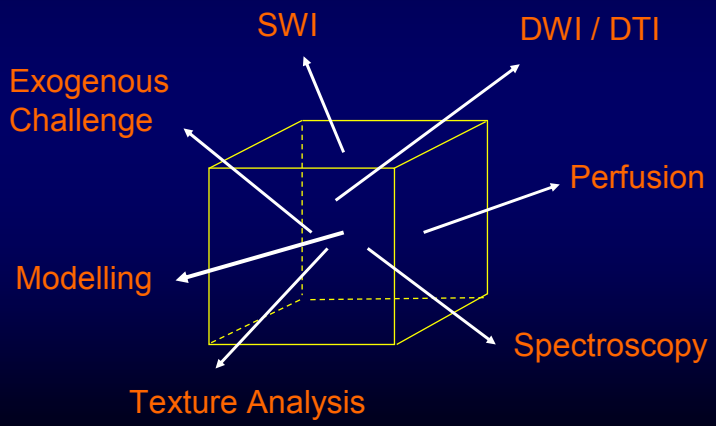
Development and Implementation of MR sequences and/or techniques

^{23}Na-Imaging

- high-field application (examples by Vienna-group)
- applicable at 1,5 T ?? (Heidelberg group)
- application in brain, cartilage, (cardiac)

WG I: Measuring Techniques: Tissue Parameters and Physiological Data

single voxel - multidimensional data



WG I: Measuring Techniques: Tissue Parameters and Physiological Data

- Increasing importance of (clinical) high-field systems (>= 3T)
- Planned short term missions (STM)
  - Jena - Vienna
  - Jena - Lódz
  - Vienna - Heidelberg
  - ...

and many more

WG I: Measuring Techniques: Tissue Parameters and Physiological Data

Next meeting in Brussels 25.-26. June 2004:

- Presentation of available techniques of WG I
- Definition of (more) projects

Annex 3

COST B21 „Physiological Modelling of MR image formation"
WG2 Meeting, Dundee, 12 March 2004

Working Group 2 "Software, simulation and modelling"

General objectives

The goal of WG2 activity is to develop methods, algorithms and software for:

- numerical modeling of MR images, taking into account properties of tissue/phantoms,
- quantitative description of MR images,
- quantitative analysis of MR images, e.g. classification, segmentation,
- continuous update of software packages developed so far within the COST B11 and B21 projects.

Moreover, members of WG2 will take part in data analysis tasks that overlap with activities of WG2 and WG3.

MaZda update plan

1. Including functionality of unsupervised image segmentation.
2. Inclusion of NIfTI file format in the image file reading routine.
3. Development of routines for computing 3D texture parameters.
4. Adding an option of "invariant" texture parameter selection (in the sense defined by D. Jirak).
5. Adding SVM classifier as a all-feature-set reference to classifiers using selected parameters.

Cooperation of the TUL team with Professor Petrou group and Dr de Certaines group is assumed for the above.

New software development

1. Vascular tree modeling; taking into account blood exchange with tissue, wall permeability, cancerous tissue growth was suggested, brain vessels modeling.
2. MRI simulator; to generate data for 2D and 3D analysis – to study correlation between simulated physical objects and their MRI properties, e.g. texture.

It has been decided that the software package will be designed and developed for computers running under MS Windows operating system. The routines for computation of texture parameters, data analysis, image formation process simulation, etc., will be written in plain C, for possible connection to other operating systems, e.g. Linux. Experimental verification (VT physical model, microscopy + MRI measurements, simulated MRI model) is planned.

The teams involved in model and software verification include people from Lodz, Bergen and Jena.

STM

Two short-term-missions are planned for Autumn 2004

- M. Kocinski (TUL) to Bergen.
- Researchers from Jena to Lodz.