IST-1999-10310 INTERPRET

Project full title

International Network For Pattern Recognition of Tumours Using Magnetic Resonance

Overview

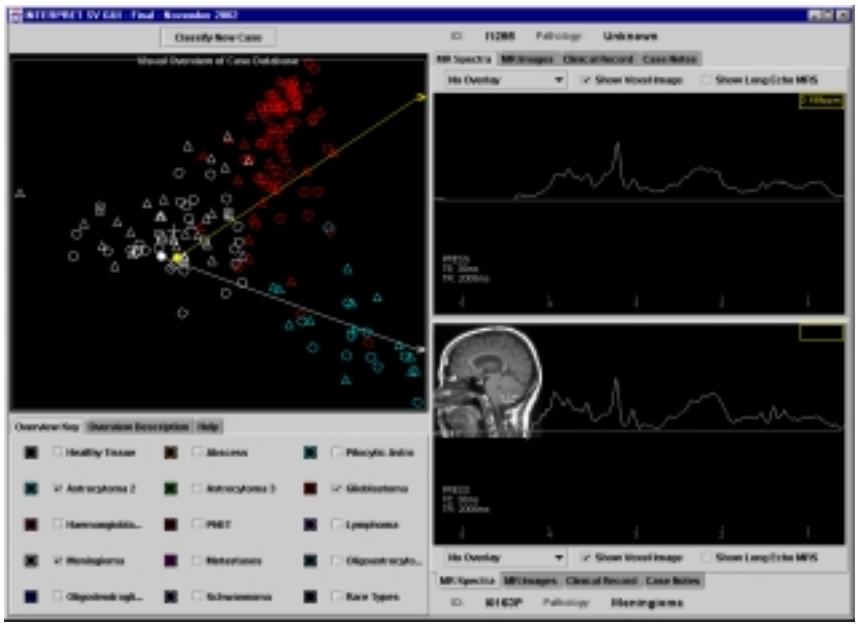

Figure legend. GUI for the SV prototype of the DSS. The new case suggested pathology classification after processing (yellow dot, left display) is shown to be in the midst of meningiomas (white symbols). Its ^{1}H MRS (top right display) can be compared with the spectrum and MR images of a close case from the INTERPRET database (bottom right).

The aim of this project has been to facilitate the use of magnetic resonance spectroscopy (MRS) for improved diagnosis and therapy of patients with brain tumours and other space occupying lesions. Spectra, easily acquired alongside commonplace MR imaging (MRI) procedures, uniquely delineate biochemistry of human tissue in situ. Although MRS gives significantly improved brain tumour categorisation, it is not widely used, partly because radiologists have difficulty in interpreting spectral data. We therefore have aimed to develop a user-friendly computer program for spectral classification. Systems development has been informed by (a) a large "training set" of data contributed by members of the consortium and (b) new spectra acquired under agreed protocols. Automated pattern recognition techniques have been developed for tumour classification together with an intuitive graphical user interface (GUI). The decision support system (DSS) developed will promote wider use of MRS, hence reducing the need for distressing and dangerous brain biopsies.

Objectives

Magnetic Resonance (MR) spectroscopy allows non-invasive visualisation of the metabolic state of organs and pathologies in the human body. The technique is well established for biochemical analysis. Excitingly, proton MR spectroscopy (^{1}H MRS) can be made available on current clinical MR imaging scanners. However, since most radiologists are not biochemists, MRS is as yet used mainly as a research tool. The aim of the INTERPRET project has been to extend the

use of MRS into clinical routine procedures with an innovative system for diagnosis and grading the malignancy of brain tumours and planning therapy. This Pattern Recognition program and its user-friendly Graphical User Interface (GUI) will accept MR spectra from advanced MRI instruments, widely available in Europe. A large database of standardised brain tumour spectra will eventually be made accessible to specialists in European hospitals.

Approach

The main tasks in the development of this system have been to:

1. Acquire and manage a much larger database of compatible MR data and associated clinical data than any currently available in order to,
2. Develop robust methods to process and classify new spectral data according to type and grade of a tumour with statistical measure of confidence.
3. Develop a graphical user-interface (GUI) which will allow the user to select and display images and spectra, and also provide a flexible range of representation of the classifier output.
4. Combine 2 and 3 to produce a user-friendly program for clinical use.

The prototypes of the single voxel (SV) and multi voxel (MV) GUI contain, amongst others, three separate "windows",

1. **The classification window** presents each spectrum as a point in a multidimensional space so that the user can compare an individual spectrum of unknown class with others for which the classification is already known. Confidence parameters from the classifier also are displayed as a further aid to clinical decision making.
2. **The image window,** which has two main purposes

a) To show the regions in the brain (*voxels*) from which the spectra are acquired.

b) For multivoxel prototypes, to present a “nosologic image” of the brain showing the classification of the different tissues within and surrounding the tumour.

The spectrum window. This displays individual spectra in standard format (*x-y* plots) together with mean and standard deviation, as well as spectra of different tumour types.

Results and Achievements

- Consensus protocols for spectroscopic and clinical data collection, admission criteria, submission format and security/data privacy precautions.
- Database with web access for use by all INTERPRET members containing data from approximately 800 human brain tumours, other pathological brain masses and normal controls and their relevant clinical data.
- Automated data manipulation and format conversion software (real time).
- A decision support system (DSS) to assist radiologists to interpret spectra from one volume of interest (single voxel, SV) or from a grid of volumes (multivoxel, MV). New ^{1}H MRS data is automatically displayed in the GUI (see attached figure) using pattern recognition

algorithms to "cluster" the cases according to their pathology. For MV-data, the probabilities of belonging to a certain tumour, tissue type or aggressivity grade can also be transferred into so-called cluster or nosologic images showing different tissue types in different colours.

- An industrial prototype of SV DSS based in the open source software model will be submitted to the EU certification process (CE marking).

Outlook

Future developments steaming from INTERPRET will be:

1. The INTERPRET SV industrial prototype will be maintained and made available to interested clinical institutions through a joint agreement between PRAXIM and another french company (SCITO).
2. A prospective evaluation of the added value of the use of industrial and scientific prototypes over conventional MRI for diagnostic purposes will be carried out by interested clinical centers.
3. Improvement of classifiers used in the DSS and merging of single and multivoxel DSS prototypes will be attempted. Funding for this will be searched either from the VIth framework EU programme or from national sources.

Conclusions

The results of INTERPRET will:

1. Enable radiologists to categorise brain tumours using MRS.
2. Aid planning of treatment and therapy.
3. Alleviate patient distress.
4. Facilitate the uptake of MRS by clinicians.
5. Consolidate MRS as a viable alternative to brain biopsy.

Contact Details

Project Name:

International Network For Pattern Recognition of Tumours Using Magnetic Resonance

Research Area:

INTERPRET has addressed key action 1.2.2. of the Vth framework IST programme (Clinical biological managerial and imaging systems for health professionals) and has contributed to extending the benefits of the information society in Europe to health professionals knowledge based decisions.

Timescale:

01.01.2000- 31.12.2002

Budget:

Overall cost: 3,068.990 €

EC contribution:2,200,000€

Keywords:

Clinical, biological, managerial and imaging systems for health professionals, brain tumour diagnosis, magnetic resonance spectroscopy.

Key Project Participants:

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