Supplementary Information for Integrated Project under VIth Framework

**Project Title:**

*Intelligent Processing Architecture for Satellite Images of Earth (IPASIE)*

**Proposer**

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**Potential Collaborators:**

1. Institute of Estuarine and Coastal Studies (IECS), The University of Hull

2. Department of Marine Biology, University of Groningen, The Netherlands


4. Belorussian State University of Informatics and Radioelectronics

5. Universita di Reggio Calabria, Reggio Calabria, Italy

**Summary**

The project outlined within this Expression of Interest builds upon a project submitted under the ISTC guidelines (B-729 "Processing and recognition of the earth surface snapshots"). It extends that work with more ambitious research objectives appropriate for a Framework 6 integrated project.

The project addresses difficult problems in the area of geo-information systems design and development where positive results will be of great interest and benefit across the European community. It aims to further research in this demanding area by providing more intelligent and adaptive, and hence usable, distributed multi-media systems.
**Need and Relevance**

Images acquired via remote sensing (i.e. satellite) provide important information to scientists and workers across many domains, such as environment, water and land use monitoring, meteorologists and geographers. However the availability of multi-media ancillary information together with raw and processed remote images provide a much wider information store useful to a wider range of users. Providing systems for these uses is itself a challenge for information (and computer) scientists. Providing the ability to gather, process and catalogue such information with the intention of providing manageable intra-European access to application driven re-interpretation of existing data, information and knowledge is a greater challenge yet again. The aim of this project is to provide intelligent system support for such requests. Such a system, capable of complex problem solving ([theme 1.2.1 complex problem solving in science, engineering, business and for society](#)), fits well with the sub-theme knowledge technologies and digital content (1.2.4) in providing a virtual knowledge space for uses of this type of information. The proposer has an extensive research background in this type of technology and research, for example cognitive and agent-based tools) applied to a number of domains geological images [1], clinical training systems in neuro-surgery involving images and clinical models [2] and business resource management [3]. Current research into theoretical aspects of cognitive models and agent architectures [4] is now ready to be applied to such information rich and computationally demanding domains.

Across Europe there exist many agencies, for example the UK Environmental Agency, that have an interest in the provision and use of remote sensing from the European Space agency to bodies making use of images from GMES ([theme 1.4.2](#)). Further interested agencies (such as the Belorussian and Universita di Reggio Calabria partners given above) exist within the context of a greater Europe. Great technical expertise exists both within core EEC countries and also in the wider European context. This project would bring together these to form a consortium of expertise capable of developing systems that made intelligent and adaptable use of remote sensing data and models.

One particular end-use of such an integrated system would its use in providing intelligent and adaptable support for the activities outlined in a further theme within the VIth framework ([theme 1.6.3 Global Change and ecosystems](#)). In particular the needs associated with monitoring land and water use, for example monitoring coastlines and water features. Expertise in this field is from two academic partners and a government agency in the UK.
Scale of Ambition & Critical Mass

This is an ambitious project requiring input from a considerable number of participants. Specific research objectives include:

1. Definition of the uses that this system can be put to. While some members of the project team have been previously engaged in military GIS application projects, we do not consider ourselves to be the end-users of this system. Hence Domain expertise is required in the themes linked under 1.6.3 is required. Partners include the Institute of Estuarine and Coastal Studies (IECS) at the University of Hull and the Department of Marine Biology, University of Groningen, The Netherlands. This will provide end-point criteria by which we can measure the strengths of the systems arising from the proposed research.

2. Gathering of satellite images and creation of multi-media database of images, elements extracted from these images and models of use in the processing of these images and to the end-users. Systematic ways of designing, building, verifying and using the computational models is needed. This will require advances to be made in adaptable architectures for scientific visualisation.

3. Development of an intelligent digital satellite image processing suite. Digital image processing expertise is available from the partners listed. They have great skills in solving the image processing problems that the project raises. These include the fast semi-automatic creation, renewal and actualization of the digital maps, aerial-photograph decoding, surface reconstruction, selection and identification of the objects on the earth snapshots concerning to monitoring the earth surface. Original methods and algorithms for digital images processing and pattern recognition will be developed. These will utilize the technologies of informative features extraction, geometric shape descriptors, classifiers using geometric transforms, cellular logic, orthogonal and moment functions, structural and statistical analysis, neural networks, discriminant function, methods of mathematical morphology and cellular logic, fast direct and inverse wavelet and other orthogonal transforms. These will improve the performance, accuracy and reliability of object recognition on GIS images.

4. The databases built through the gathering of images, models and their processing will be quite extensive. As such they will address many issues in the design and implementation of distributed multi-media research. The proposer has past experience (with EPSRC and AIM funded) projects, further expertise (available from within the University of Hull) is available.
5. Development of an intelligent computational infrastructure capable of supporting the needs associated with the above objectives. The proposer also has considerable expertise in building multi-media decision support tools using agent-based technologies. Further expertise in the University of Hull is available in terms of distributed and mobile agent-based computing infrastructure and in the control of adaptive heterogeneous architectures.

6. The user and operability issues associated with the multiple-domain use of this system raises many research questions associated with knowledge spaces and how best to present these in a manageable fashion to end-users. Hence cooperative visualisation over a distributed multi-media task oriented system is an important issue. This is an issue that an earlier EU-funded project (EU Framework IV Telematics Project RE 1006 – manicoral) addressed. This work will need to be revisited from the perspective of intelligent and adaptive architectures for visualisation. Again expertise is available from within the University of Hull.

**Integration**

Shared work and information spaces is an issue in any large project. Part of this project will involve the need to improve the utilisation of virtual and interactive research methods, including the coordination of electronic documents, data, information and software. This is particular so where the research and work ethos ranges so widely across the consortium partners. The project will require that key personal work at different partner sites during different stages of the project.

Dissemination of knowledge will be through the usual channels via research publication. Regular consortium wide workshops will be necessary in delineating research objectives, and clearly establishing the management roles within the consortium. The results of the research (such as the database, software, reports and publications) can be made available from multiple Internet sites from within the research consortium.

At a global level the main lines of the research are as detailed in the previous section. The following lists the personnel and associated tasks from the main partners:

- **Belorussian State University**: The project group consists of 19 scientists and experts and auxiliary 7 workers from Belarussian State University of Informatics and Radioelectronics. Their involvement in this project in developing image processing and model based software is likely to amount to approximately 630 man–months.
• **University of Hull:** The project group consists of 5 full-time-members of staff plus a prospective 10 Ph.D. students over the five year project, 4 research fellows plus ancillary and support staff. This is likely to total 650 man-months effort. This will cover the research into visualisation for co-operative working (headed by Dr H. Wright and Dr D.P. Wills), the development of distributed multi-media databases (Dr B. Wang), agent-based computational infrastructures (Dr D. Grey, Dr Davis), agent-based computation for machine vision (DR Davis), adaptation and intelligent control over a heterogeneous information processing infrastructure (Dr C. Kambhampati, Dr Davis) and cognitive model for task definition and computational information processing infrastructures (Dr M. Brayshaw, Dr C. Kambhampati, Dr Davis).

Environmental experts and centres include:

• Dr Mike Elliot, director of **The Institute of Estuarine and Coastal Studies (IECS).** This is a multi-disciplinary research and consultancy organisation set up to utilise the facilities and expertise in coastal science and management within the University of Hull.

• Dr Alison M Matthews at the UK government’s Environment Agency (**National Centre for Environmental Data and Surveillance**, Bath).

• Dr Victor N. de Jonge at the Department of Marine Biology, **University of Groningen,** The Netherlands.

**References**


