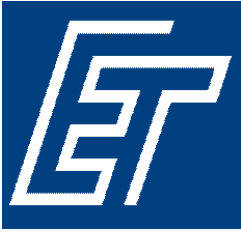




PARTNERSHIP PROPOSAL

BY

**MULTIMEDIA TELECOMMUNICATIONS GROUP
POZNAŃ UNIVERSITY OF TECHNOLOGY - POLAND**



Multimedia Telecommunications Group
Institute of Electronics and Telecommunications
Poznań University of Technology - Poland

The **Multimedia Telecommunications Group**:

Prof. dr hab. inż. Marek Domański – Head of the Division,
Dr inż. Maciej Bartkowiak, Dr inż. Sławomir Maćkowiak, Dr inż. Roger Świerczyński
Mgr inż. Adam Łuczak, Mgr inż. Łukasz Błaszak, and PhD students.

The team has an international reputation for research on **image and video compression and processing**, and particular expertise and research interests in:

- **algorithms for image and video compression, scalable video coding,**
- **video coder modelling and bitrate control,**
- **MPEG 2/4, H.263, AVC video codec implementations, testing and modifications,**
- **JPEG, JPEG-LS, JPEG 2000 image compression and extensions,**
- **subband/wavelet-based analysis and compression of images and video,**
- **telemedicine, medical imaging,**
- **multimedia systems,**
- **video surveillance,**
- **chrominance representation, compression and colour transformations,**
- **irregular sampling of colour images, interpolation schemes,**
- **colour image and video enhancement and restoration,**
- **theory of linear and nonlinear digital filters,**
- **multidimensional digital filters and filters for image and video processing,**
- **image authentication by digital watermarking.**

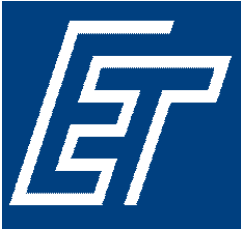
The original R&D achievements include: scalable schemes for video coders, new models for hybrid video coders, schemes for video coder bitrate control, own MPEG-2 and H. 263 software implementations, AVC software extensions, MP4 decoding, compression error analysis, proposals for near-lossless compression, original proposals for still images and video subband/wavelet compression, development of a telemedicine system, new contributions to chrominance representation and compression, colour transformation error analysis, interpolation schemes, techniques for image and video restoration, new filter structures, low-sensitivity filters, original solutions for filter structures and inherent stability of multidimensional filters etc.

Teaching: image and video engineering, multimedia systems, analog and digital television, signal and system theory, electronic systems (analog and digital).

Politechnika Poznańska (Poznań University of Technology – PUT) is a large research-led university of technology. PUT is highly regarded for its research on signal processing, communications and multimedia.

Institute of Electronics and Telecommunications (IET) at Poznań University of Technology is one of the top rated research and educational institutions in Poland. It maintains standards of excellence in teaching and research, leadership in professional affairs and high visibility. The IET was established in 1974, when it was named the Institute of Electronics. In 1985 the Institute of Electronics was renamed the Institute of Electronics and Telecommunications to reflect major changes in research and education which have occurred in the last decade. IET mission is to provide graduate and undergraduate education and to conduct research in information and communication technologies. Innovation and breadth of opportunity are the hallmarks of the IET educational experience. All available courses are designed to meet a variety of challenges by providing professional training as we continue to respond to the diverse needs of the information age.

Detailed description of the projects, partners and publications of our Group is given later in this Proposal.



Multimedia Telecommunications Group Selected Projects

MASCOT - Metadata for Advanced Scalable Video Coding Tools is a joint effort between eight research groups in Europe. MASCOT seeks to design an intrinsically scalable video coding scheme providing fully progressive bitstreams by exploiting **novel morphological and adaptive wavelet decomposition methods**. Furthermore, the project aims to improve the quality and efficiency of **video coding systems by exploiting metadata information**. Our staff is responsible of the developing intrinsically scalable compression schemes, which fulfil the requirements of multimedia applications.

The project takes place from May 2001 to April 2003 and is supported by the **European Commission** under the FET part of the Information Society Technologies programme of the **Fifth Framework**, as project number IST-2000-26467.

OMNI - Open Model for Network-Wide Heterogeneous Intersection-based Transport Management is a project aiming to develop a model of **transport management** enabling the integration of the following applications:

- surveillance - an automatic incident detection application using video sensors;
- advanced traffic control systems - a number of different adaptive traffic control strategies and architectures will be assessed;
- WWW application: end user transport information on the web.

OMNI is a network-wide, intersection driven model, acting as an intermediate layer and isolating the actual network infrastructure from the applications that are using it. OMNI models the network components (such as sensors, lanes and local controllers) considering both their physical characteristics and their functionality. Our staff works with the problem of the **project results evaluation**. The project takes place from March 2000 to February 2003 and is supported by the **European Commission** under Information Society Technologies programme of the **Fifth Framework**, as project number IST-11250.

Software Implementation for MPEG-4 project (2000-2001) by Heinrich Hertz Institut (currently Fraunhofer-Institut für Nachrichtentechnik Heinrich-Hertz-Institut, Berlin) was aimed of developing MPEG-4 implementation in cooperation with German SME. Our staff has realized a software module responsible of audio-visual data streams writing into **mp4 files**.

Very Low Bitrate Coding of Video was the collaborative project with Institut für Nachrichtentechnik und Informationsverarbeitung, Universität Hannover. Two main developed video coding schemes was based on:

- transform coding combined with vector quantization and subband coding;
- object-based methods.

The project has contributed important improvements related to both algorithm groups. The object-based methods have been developed in Hannover while other techniques have been improved in Poznań or jointly. Two chrominance components have been converted into one scalar component and transform coded. The mutual correlation of luminance and chrominance has also been used. An original technique to encode high-frequency subbands of 3-D scheme has been proposed. A proposal of object-based layered codec has been submitted for formal testing during the ISO MPEG-4 standardisation process. The project took place from 1996 to 1998 and was supported by **NATO International Scientific Exchange Programme HT 941338**.

INVOCOM - Internet Based Vocational Training of Communication Studies. Engineers and Technicians is a project prepared together with laboratories from France, Finland and Ireland. The aim is to prepare the **WWW based interactive exercises** concerning selected aspects from telecommunications and informatics theory and applications, according to the experience with traditional laboratory courses already given for students and technicians. The user interface is based on interactive Web pages. Data collected from the user are sent via networks to a specialised program that performs appropriate operations for a given topic. Output data are presented as a new Web page. Our role is to prepare the exercises concerning image and video coding, enhancing and transmission. Project is contracted on period 2002 – 2005 by the **European Commission** under **Leonardo da Vinci** Programme as project number PT02/PP/01/36/011.

Merging of Telecommunication and Computer Technology was another joint work resulting in developing and introduction of two new specializations : teleinformatics (engineering and technology) and telepathology (new technologies in medical diagnostics and treatment). Our Institute gave the Department of Pathology, Karol Marcinkowski University of Medical Sciences in Poznań **technical expert advice** and consultation on the **development of communication infrastructure and computer facilities** necessary in medical diagnostic and treatment. The program took place in period 1996-1999 and was supported by the **European Commission** under **Tempus** Programme as contract number S_JEP-11118.

A Modern BSC Programme in Electronics and Telecommunication was a joint effort between a view universities in Europe resulting in the modern Bsc curriculum in Electronics and Telecommunications at Poznań University of Technology. This was one of our first international projects (1994 – 1997) helping us to establish as well educational as research contacts with many European laboratories. The program was supported by the **European Commission** under **Tempus Programme** as contract number S_JEP-07543-94.

Telepathology Using Internet project concerned **telemedical applications**, where selected microscopic histological images available in one site are consulted by specialist located in one or more other sites connected with the telecommunication network. Since the needed high resolution and lossless compression of images, the communication channels ensuring the 100 Mb/s transmission rate has been used. During the project our group has implemented:

- **C++ software package for the server** controlling the microscope connected with the high resolution (1600x1200) colour camera;
- an original algorithm for lossless image compression;
- videoconferencing system under Windows NT, allowing the audio-visual communication, chat-like communication and pointing regions of the image;
- **client package prepared in JAVA** language allowing the distant user to control the microscope state and viewing the high-resolution microscopic image as well as starting the videoconference;
- the restricted version for students (no microscope control).

The project took place from 1998 to 1999 and was supported by the **Stefan Batory Foundation**.

Other research projects supported by Polish Government in the form of State Committee for Scientific Research (pl: KBN - Komitet Badań Naukowych) grants (selected list) :

Automatic Colour Video Segmentation project will ends with proposing and testing new algorithms of automatic semantic (i.e. having some sense from a point of a human-being) objects extraction for a transmission compatible with MPEG-4 standard. Irrelevancy for shadows and global illumination changes is expected. The project is contracted for the period 2002-2003 as a grant no. 4 T11C 014 23.

New Efficient Techniques for Video Coder Control project is expected to provide new algorithms of coding controlling procedures for video compression standards MPEG-2, MPEG-4, H.26L and spatio-temporal scalable coders previously developed by our group. The main target are constant bit-rate coders, but VBR coders will also be considered. The project is contracted for the period 2002-2003 as a grant no. 4 T11D 007 22.

Errors Accumulation in Image Processing project will analyse the process of errors accumulation in the situation of several coding/decoding operations. This will lead us to formulate conditions allowing avoiding, or - at least – limit it's influence. We will focus especially on chrominance transformation operations and compression processes used in international standards as well as new methods presented in literature. The project is contracted for the period 2002-2003 as a grant no. 4 T11D 014 23.

Irregular Representations of Multidimensional Signals for Digital Image and Video Processing project concerns irregular image sampling and image representation as a set of irregular objects. Expected results are effective algorithms:

- image representation using samples placed on irregular grid;
- compression of irregular sampled images;
- decoding of regular sampled image;
- coding of irregular objects based on shape adaptive transformations.

The project is contracted for the period 2000-2002 as a grant no. 8 T11D 004 19.

Hierarchical Video Compression Techniques for MPEG Systems in Heterogeneous Communications Networks project improved previous (KBN no. 8 T11D 007 11) solutions using:

- new prediction method in B-pictures;
- more effective coding of low frequency subband ;
- multilevel SNR-like scalability.

Some presented modifications has been presented to the standardization body. The project was contracted for the period 1999-2001 as a grant no. 8 T11D 009 17.

Algorithmic and Hardware Structures for Digital Video Processing project ended with:

- developing effective algorithms for non-linear image and video filtration, based on decision process, giving high texture and details preserving ability;
- 3-D non-linear filters for interlaced video signals;
- effective chrominance representation based on segmentation, vector coding and prediction;

Developed algorithms has been implemented in the FPGA technology and also in the form of microchip in AMS CMOS 0,8 and 0,6 technology. The project was contracted for the period 1998-2000 as a grant no. 8 T11D 018 15.

New Techniques of Colour Video Compression project ended with:

- scalable subband coding allowing higher error resilience;
- enhanced chrominance channels coding
- enhanced irregular shape objects coding;

the obtained coder produces scalable stream of size and quality comparable to the non-scalable MPEG-2 stream. More over, the base layer of proposed scheme is fully compatible with standard solution. The project was contracted for the period 1997-1999 as a grant no. 8 T11D 007 11.

New Techniques for Synthesis of Fast Digital Filters project resulted in:

- developing of new fast FIR filtering algorithms based on FFT;
- rounding errors analysis for filters based on DCT;
- analysis of multidimensional filters design for image processing.

The project was contracted for the period 1997-1999 as a grant no. 8 T11D 011 09.

Multispectral and Multiresolution Video Compression Techniques project was aimed to finding new effective techniques of video information in digital channel from videoconferencing up to TV. The main area of works was multidimensional techniques – like subband and wavelet analysis. The proposed methods are characterized by low computational cost and 3-D scheme. Main advantage of such structure is its intrinsic scalability. Effective chrominance channels coding based on its correlation has also been proposed. The project was contracted for the period 1995-1997 as a grant no. 8 S504 002 06.



Multimedia Telecommunications Group Awards and distinctions

2002 - Distinction of the Association for Image Processing for the best presentation at the International Conference on Computer Vision and Graphics ICCVG'2002 (given to Roger Świerczyński)

2001-2002 - Annual Fellowship for Young Scientists by the Foundation for Polish Science (FNP - Fundacja na Rzecz Nauki Polskiej) (given to Sławomir Maćkowiak)

2001-2002 - Annual Fellowship for Young Scientists by the Foundation for Polish Science (given to Adam Łuczak)

2000 – Award of Polish President's Economic Prize Laureates Lodge (given to Maciej Bartkowiak)

2000 - Award of Foundation for Supporting Radiocommunication and Multimedia Techniques Development for the best presentation at the Telecommunications Systems and Technologies Conference (given to Sławomir Maćkowiak)

1999 - Award of the Minister of the National Education for research in image compression

1998-1999 - Foreign Postdoctoral Fellowship by the Foundation for Polish Science (given to Roger Świerczyński)

1997-1998 - Annual Fellowship for Young Scientists by the Foundation for Polish Science (given to Maciej Bartkowiak)

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