MUSCLE

Network of Excellence

Multimedia Understanding through Semantics, Computation and Learning

Project no. FP6-507752

Bi-Monthly Progress Report #15: Jul – Aug 2006

Due date of deliverable: 15.10.2006
Actual submission date: 20.10.2006

Start date of Project: 1 March 2004 Duration: 48 Months

Name of responsible editor(s):

- Remi Ronchaud (remi.ronchaud@cwi.nl)

Revision: 1.0

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including Commission Services)	
RE	Restricted to a group specified by the consortium (including Commission Services)	
CO	Confidential, only for members of the consortium (including Commission Services)	

Keyword List:

Contents

1 Overview activities in WP 1

1.1 General Scientific and Administrative Coordination

- Administrative and financial coordination of the network;
- Organisation of regular audio conferences;
- Reimbursement of MUSCLE integration expenses (mobility support grants);
- Follow-up and posting of the deliverables.

2 Overview activities in WP 2

2.1 Contribution by CWI

Researchers involved: Eric Pauwels

- Supervised and assisted migration of Muscle website and databases to new ERCIM server (new webmaster);
- Designed, implemented and processed on-line questionnaire on Muscle's internet tools for web-based collaboration.

3 Overview activities in WP 3

3.1 Contribution by TUVienna-PRIP

Researchers involved: Allan Hanbury,

Activities Organising MUSCLE evaluation activities in 2006. These include:

- CIS coin competition (in collaboration with ARCS)
- Some tasks in the ImageCLEF evaluation campaign

Two MUSCLE-sponsored workshops related to these activities have been organised. The CIS competition result workshop took place on the 11th of September in Berlin, Germany (before the DAGM conference). The prize for the best performing program was won by Marco Reisert from the Chair of Pattern Recognition at the University of Freiburg (a MUSCLE member). He basically solved this rather difficult problem, obtaining a classification rate of 97.2% on the unseen dataset. All other coins were classified as unknown, meaning that he made no false classifications.
A press release is being prepared. It is also planned to write short articles on the results of this competition for the ERCIM news, MUSCLE webpage, ICPR newsletter. The proceedings and results will also be online shortly.
The MUSCLE/ImageCLEF 2006 workshop took place on the 19th of September in Alicante, Spain (before the CLEF workshop). The invited speaker was Mark Everingham, co-organiser of the PASCAL Visual Object Challenge. We had representatives from three major evaluation campaigns present: PASCAL VOC, ImagEVAL and ImageCLEF. One of the main outcomes of the workshop is the possibility of greater cooperation between ImageCLEF and the PASCAL VOC. This will be discussed over the following months as we prepare evaluation campaigns for 2007.

Publications MP-codes:

3.2 Contribution by CEA

Researchers involved: Moellic Pierre Alain, Christophe Millet

Activities Activity Works for the E-Team : Choosing Features for CBIR and Automated Image Annotation - Evaluation of the animal recognition system according to several features selection

Publications MP-codes:

3.3 Contribution by UPC

Researchers involved: Montse Pardas,

Activities Ground truth generation for the E-team "Selecting features for CBIR and Automated Image Annotation". We have provided provided ground truth segmentation of the assigned animal images from the Corel database.

Publications MP-codes:

3.4 Contribution by

Researchers involved: Moellic Pierre Alain, Christophe Millet, Adrian Popescu, Patrick Hede

Activities Activity ImagEVAL campaign :
- Official campaign (5 tasks)
- Discussions about the final conference

Publications MP-codes:

4 Overview activities in WP 4

4.1 Contribution by INRIA-Ariana

Researchers involved: Ian Jermyn, Josiane Zerubia

Activities Josiane Zerubia attended ICASSP 2006 in May to present work performed within Muscle. Also in May the Director of Research of the French National Geographic Institute (IGN) visited INRIA-Ariana, and presentations of Muscle research were made, followed by discussions. Josiane Zerubia attended the Symposium of the International Society for Photogrammetry and Remote Sensing (ISPRS).

Publications MP-codes:

5 Overview activities in WP 5

5.1 Contribution by TUVienna-PRIP

Researchers involved: Allan Hanbury,

Activities Collaboration with Beatriz Marcotegui of ARMINES-CMM in the framework of the E-team on "Choosing Features for CBIR and Image Annotation" on the following topics:

- Segmentation of images using the waterfall algorithm and watershed using volume extinction values on colour-texture gradients
- Matching of images using 2D colour histograms

Extensive experimentation on both of these topics has been done in the past two months. Two joint journal papers are under preparation, of which one will be submitted within the next two weeks.

Publications MP-codes: 181

5.2 Contribution by TUVienna-PRIP

Researchers involved: Allan Hanbury, Lech Szumilas, Branislav Micusik

Activities E-team on "Choosing Features for CBIR and Automated Image Annotation".

- Collaboration with ARMINES-CMM on image segmentation and matching.
- Collaboration with KTH on texture features and scale detection.
- Collaboration with CEA on topics related to recognition of animals.

The following MUSCLE mobility grants have been used within this E-team (see the mobility grant reports for more specific descriptions of what was done during each visit):

- Lech Szumilas visited the CMM in October 2005 for a course on morphological segmentation.
- Allan Hanbury visited the CMM in April 2006 to continue work on segmentation and matching.
- Alireza Tavakoli Targhi (KTH) visited PRIP in March 2006. Work was done on texture features and automatic scale detection for animal recognition.
- Christophe Millet (CEA) visited PRIP in June 2006. The first experiments on animal recognition using Support Vector Machines were done.
- Lech Szumilas visited KTH in July 2006. Further work on texture features and animal recognition was done.

As a result of these exchanges, a joint KTH-PRIP paper was published in the 2nd MUSCLE workshop on Image and Video Retrieval Evaluation. Further joint papers are currently under preparation.

Publications MP-codes: 181,500

5.3 Contribution by TUVienna-PRIP

Researchers involved: Allan Hanbury, Lech Szumilas, Branislav Micusik and Masters students

Activities Development of image segmentation algorithms which segment an image based on a sample of the texture to be found. This sample must be specified in advance by the user. The algorithm then attempts to mark all the regions in the image which correspond to the specified texture. It makes use of the minimum cut/maximum flow algorithm on a graph representation of the image. This problem is an instance of the one-class classification problem, as we have information on the texture to be located, but no information on the "background" (the rest of the image). This algorithm has been further developed to be fully automatic, yielding good results which will be presented at the ECCV 2006. Improving the efficiency of this method by creating a graph based on the results of a Maximally Stable Extremal Region (MSER) detector instead of directly on the pixels has been done and the results have been presented at the British Machine Vision Conference in September. All the above work has used a two-class maximum flow/minimum cut optimisation algorithm to calculate the segmentations. This means that segmentations into many regions must be done iteratively. Work using multi-class optimisation algorithms is underway.
A texture detector for automatically locating textures in an image has been developed. It tries to find alternating colour patterns within an image using a clustering technique. The detected texture patches are then passed to the segmentation algorithm described above to attempt to locate the whole texture. The results of this work will be presented at the International Symposium on Visual Computing in November 2006.
Image segmentation by agglomerative hierarchical clustering in the CIELAB colour space has been investigated. To make this approach computationally feasible, an initial over-segmentation of the image was applied to reduce the number of colours in the image. A journal paper on this approach has been submitted.
An algorithm for classifying images into categories such as city/nature and inside/outside has been developed. It has been entered into the ImagEVAL evaluation campaign.
We have also investigated the keywords which have been used to annotate images in currently available image datasets. This has resulted in the creation of a combined keyword list.

Publications MP-codes: 200,204,218,291,292,472

5.4 Contribution by UCL

Researchers involved: Fred Stentiford, Li Chen Adetokunbo Bamidele Shijie Zhang

Activities Task 2: Image and Video Processing
Sub-task 4: Saliency detection and visual features configuration
Work at UCL has concentrated on detecting new forms of saliency that are relevant to the understanding of visual content. A framework for attention mechanisms has been developed that enables different structures to be identified in images by incorporating transforms that correspond to the features being sought.
Reflective symmetries are detected using an attention mechanism in which pixel configurations are transformed through reflections before translation and checking for a match. Peaks in the distributions of reflection axis angles at which matches are found indicate the locations and strengths of the symmetries present in the image. The mid points of lines joining corresponding fork pixels lie along the axis of symmetry of the shape. Forks include some pixels that mismatch each other; this ensures that emphasis is given to image regions that contain attentive material. Papers were presented at ICAPR 2005 and MMSP 2005. In a similar fashion measures of perspective are computed using a scaling transform before testing for a match. Peaks in the distributions of matches across the image indicate the locations of vanishing points in the image. A paper has been submitted to ICIP 2006.
Earlier work on attention-base similarity has led to the development of a new algorithm that extracts colour correction parameters from pairs of images and enables the perceived illumination of one image to be imposed on the other. This time colour transforms are used as a means of obtaining the relative illumination between two images. The colour shift that stimulates the highest frequency of matches represents a measure of the relative illumination of the two images. We apply the reverse colour shift to

pixels in the second image to obtain a transformation that approximates the illumination present in the first image. The work was presented at SPIE in January 2006 and an internet service has been established to evaluate usability and acceptability (http://colourcorrection.bat.bt.co.uk/ColourCorrection/).
Attention based methods for motion estimation are being investigated that do not depend upon specific features which are thought to characterise foreground objects or background regions. The technique maps attention mechanisms in time and generates motion vectors for each frame in a moving video sequence. Results have been compared with motion vectors derived from MPEG video encoders.
Whilst experimenting with real time DSP implementations of visual attention algorithms applied to video camera outputs, it has been observed that the highest measures of saliency in images are obtained at the point of best focus. This work promises to offer new techniques for optimising the informativeness of images during focusing operations or through the variation of other parameters e.g. spectrum of illumination, brightness, etc. A paper has been submitted to ICIP 2006.
Visual attention algorithms have also been used to guide the selection of seed points for region growing in image segmentation. Points of low attention are normally present in large areas of self-similar background regions that are easy to segment, whereas high attention regions are often in the vicinity of rapidly changing features where segmentation needs to be constrained.
Several findings from research on Content Based Image Retrieval have been published that have used attention based similarity measures. Most significantly attributes derived from a combination of contextual metadata and image similarity have been used to indicate the location at which camera phone images were taken. In this work the problem of image classification by grouping images into visual clusters and combining this with contextual metadata was undertaken with some success using a very diverse set of images. This work was presented at SPIE in January 2006.
Personnel exchanges with INRIA are planned for the end of April during which ideas taken from saliency research will be applied to problems in copy detection.

Publications MP-codes: 206, 207, 220

5.5 Contribution by UCL

Researchers involved: Fred Stentiford, Li Chen, Rob Shilston, Ade Bamidele

Activities Work has continued in collaboration with INRIA-IMEDIA on video copy detection. Following Li Chens visit to INRIA in April, a return visit by Julien Law-To is planned for early August during which an evaluation of several detection techniques will be carried out. Work on attention based similarity measures has also been applied to copy detection in still images. A paper on Near-Duplicate Image Matching has been submitted to CVMP 2006. A paper entitled Attention-Based Similarity has now been published online in the journal Pattern Recognition. The demonstration of attention based focusing is now working through local PTZ cameras as well as remote cameras that are connected to the internet. The photo colour correction technique reported earlier forms the basis of an award of an NCGE fellowship to Ade Bamidele. This will enable him to travel the US for 6 months and establish a case for a spin out company based on this technology.

Publications MP-codes: 465,467

5.6 Contribution by UCL

Researchers involved: Fred Stentiford, Li Chen, Shijie Zhang

Activities Work at UCL has continued to explore attention-based mechanisms.

- A paper entitled: Comparison of near-duplicate image matching, is to be presented at the 3rd European Conference on Visual Media Production. This work uses an attention based similarity measure to identify slightly distorted copies.

- Julien Law-To from INRIA is paid a return visit to UCL in August to continue the collaboration on copy detection. Data has been exchanged and experiments have neen conducted to enable objective performance comparisons to be made.

Publications MP-codes: 485

5.7 Contribution by TUVienna-IFS

Researchers involved: Thomas Lidy, Andreas Rauber

Activities participated in the annual Music Information Retrieval Evaluation eXchange (MIREX), a benchmark forum for Audio Retrieval Feature Extraction Algorithms

Publications MP-codes:

5.8 Contribution by ACV

Researchers involved: Herbert Ramoser, Csaba Beleznai, Julia Puckmayr

Activities The AdaBoost training algorithm has been evaluated with respect to different feature types including motion features. The results indicate that the choice of both positive and negative training samples is crucial. So far there is only limited success in constructing a classifier which shows a good performance for a wide range of scenarios. Bests results are achieved when the classifier can be tuned for the specific target application.

Publications MP-codes:

5.9 Contribution by MTA-SZTAKI

Researchers involved: Dmitry Chetverikov, Fazekas, Sandor

Activities Preparation of join submission, with TAU, on optic flow for dynamic texture

Publications MP-codes:

5.10 Contribution by TUG

Researchers involved: Horst Bischof, Helmut Grabner, Michael Grabner, Peter Roth, Thomas Mauthner, Horst Bischof

Activities

1. Ongoing experiments for developing a robust AdaBoost algorithm.
2. We are working on the improvement of hierarchical agglomerative clustering for fast indexing.

Publications MP-codes:

5.11 Contribution by INRIA-Ariana

Researchers involved: Ian Jermyn, Josiane Zerubia, Dan Yu, Peter Horvath, Ting Peng, Saloua Bouatia.

Activities All publications on INRIA-Ariana's work related to Muscle may be found

- http://www-sop.inria.fr/ariana/en/publications.php?name=Jermyn
- http://www-sop.inria.fr/ariana/en/publications.php?name=Scarpa

Ariana's work in WP5 involves two areas: modelling images and modelling regions in the image domain. Together, as likelihood and prior, they enable the extraction of the regions in images corresponding to particular entities.
Image modelling: the work of Dan Yu, postdoc in INRIA-Ariana this year, on adaptive wavelet packet texture models has continued. As reported last time, Ms Yu has been using a brushlet basis in order to increase the angular resolution of the adapted basis, since the eventual goal is implicit rotation invariance. The brushlet basis is a complex basis with similar properties to the Fourier basis for real images. In particular, the phase of a brushlet coefficient varies approximately linearly with translation and a translation invariant probability distribution with independent coefficients thus depends only on the magnitude of the coefficients. In combination with the bimodal distributions discovered in previous work with real wavelet packet bases (see previous reports), this suggests that the statistics of adapted brushlet subbands will show 'inverted champagne bottle' behaviour, that is, the histogram of the complex coefficients will be rotationally symmetric (uniform phase distribution) with a peak at some magnitude and a minimum at zero. This is indeed what is observed. Ms Yu has adapted to the complex case the quartic models developed by Johan Aubray for real wavelet packets (see previous reports). Surprisingly, the learning problem simplifies somewhat in this case as the normalization constant takes a simpler form. The models appear to capture the statistical behaviour effectively. Ms Yu is currently working on joint estimation of the model and the parameter that penalizes bases with many subbands, which has previously had to be set by hand, and on testing the models via sampling.
Image modelling: work has continued on the construction of image models for the extraction of road networks from Very High Resolution (0.5m) satellite images. After intensive study of the one- and two-point statistics of wavelet and scaling coefficients for the roads and the background, Ting Peng, joint PhD student of INRIA-Ariana and the LIAMA Institute in Beijing, has constructed an image model that takes into account several scales simultaneously, and which produces good although by no means perfect results. This is based on mixture of Gaussian models of the one-point statistics of the scaling coefficients in each scale, while the two-point statistics are modelled via the variance of the scaling coefficients in a window using Gamma distributions.
Region modelling: the errors that arise using the model described in the previous paragraph seem due primarily to weaknesses in the prior model, which is defined at the finest scale. Ms Peng's current work is focused on constructing a multiscale version of the prior, which would also enable improved computational efficiency, and on creating a more complicated interaction structure in which the interaction range and strength depends on the road direction.
Region modelling: the higher-order active contour (HOAC) model for a 'gas of circles' has been further advanced by Peter Horvath, joint PhD student of INRIA-Ariana and the University of Szeged. This model is being applied to the extraction of tree crowns from remote sensing images. As explained in the previous report, one of the remaining sources of error in the results arises when the area between two nearby trees strongly resembles a tree crown. The current model tends to form a dumbbell shape, with two circles linked by a 'bridge'. Our previous idea was to design a new interaction function to change this behaviour, but via an analysis of the behaviour of the energy for two nearly touching circles, Mr. Horvath has found constraints that must be placed on the parameters of the current model in order for two nearby circles to repel one another. These constraints appear to be compatible with constraints arising from other desiderata, and so the current model with constrained parameters is sufficient to achieve our aim. Testing of these theoretical results is now under way.

Publications MP-codes:

5.12 Contribution by TAU-visual

Researchers involved: Nahum Kiryati, Tomer Amiaz

Activities Development of a method for video analysis, capable of labeling dynamic texture regions (smoke, waterfalls, etc.) even in the presence of other types of motion, e.g., camera motion.

Publications MP-codes:

5.13 Contribution by AUTH

Researchers involved: Costas Cotsaces, Nikos Nikolaidis, Ioannis Pitas

Activities Feature point selection for object recognition and retrieval and pose estimation (integration and research visit).
Task 2: Image and Video processing
AUTh PhD student Costas Cotsaces visited TUG with the intention of conducting joint research on the subject of feature point selection for object recognition and pose estimation. Specifically, the intention was to utilize TUG's expertise on the subject of feature point selection in order to devise a method to select feature points that are optimal for a specific class of objects. The class of objects that were used were articulated hands, which are currently the subject of AUTh research. It was decided that the best course would be to pre-select feature point candidates using a traditional approach (specifically SIFT) and filter them according to a measure of their appropriateness. Special attention was also paid to developing a method for feature selection that would be computationally extremely lightweight, so that it could be used to evaluate a large number of feature points (in the future perhaps obviating the need for a pre-selection stage). Methods from the field of data mining (trained on available examples) were used to evaluate the goodness of specific feature points. Results from this joint research and integration are projected to be published as a conference paper. Additionally an evaluation of different feature point selectors for the task of hand posture estimation was performed.

Publications MP-codes:

5.14 Contribution by CNRS

Researchers involved: Debili Fathi, Zied Ben Tahar, Emna Souissi

Activities Morphosyntaxic analysis of Arabic with a double concern: to make converge automatic analysis and the manual annotation, tagging and dependency analysis.

Publications MP-codes:

5.15 Contribution by CEA

Researchers involved: Moellic Pierre Alain, Christophe Millet

Activities Activity Activity Works for the E-Team : Choosing Features for CBIR and Automated Image Annotation
- Merging several features (colour and texture) for a recognition using SVM (Multiclass strategy)

Publications MP-codes:

5.16 Contribution by UPC

Researchers involved: Montse Pardas,

Activities Mehmet Turkan (graduate student at Bilkent under the supervision of WP11 Leader Prof. A. Enis Cetin) has visit UPC for work in the framework of e-team on Person Detection, Recognition and Tracking. We have investigated the feasibility of the use of Turkan's method for face location for localizing the position of eyes in a face image.

Publications MP-codes:

5.17 Contribution by INRIA-Parole

Researchers involved: Yves Laprie,

Activities Speech Analysis:
We have improved the automatic formant tracking algorithm based on concurrent curves proposed in 2004 and implemented a complete copy synthesis scheme in WinSnoori that enables acoustic stimuli to be generated almost automatically from a speech signal. The improvement concerns the initialization of the concurrent curve and the control of their evolution. It consists of evaluating the class of vowels particularly when their first two formants have a low frequency (mainly vowels /u/ and /o/). This improvement enables the tracking to be more relevant and prevents it from searching the second formant in higher frequency regions (higher than 2000Hz).

Publications MP-codes:

5.18 Contribution by INRIA-Imedia

Researchers involved: Valrie Gouet-Brunet, Julien Law-To, Olivier Buisson, Nozha Boujemaa

Activities We proposed an efficient approach for copies detection in large archives consisting of several hundred hours of videos. Our video content indexing method consists in extracting the dynamic behavior of several kinds of interest points of different natures (Harris and symmetry points). Analysing the low-level description obtained allows to highlight trends of behaviors and then to assign a label of behavior to each local descriptor. Such an indexing approach has several interesting properties: it provides a rich, compact and generic description, while labels of behavior provide a high-level description of the video content. A dedicated on-line retrieval method for copy detection is described, compared and evaluated on several difficult cases. Our system shows an excellent robustness to various severe signal transformations and an accurate distinctiveness to high similarities which are not copies.

Publications MP-codes: 506,507,508,509

5.19 Contribution by CNR-ISTI

Researchers involved: Ovidio Salvetti, Sara Colantonio, Davide Moroni

Activities

- Development of a method for colour image classification based on a fuzzy-neural approach. Applications to cell images
- Development of a method for dynamic shape characterization. Application to heart dynamics

Publications MP-codes:

5.20 Contribution by FORTH

Researchers involved: Panos Trahanias, Antonis Argyros, Manolis Lourakis, Iason Economides

Activities FORTH has continued work on symbolic object detection and cognition, an more specifically on visual detection and 2d/3d tracking of objects according to colour information. FORTH has also continued work on methods to utilize motion information as a means to improve results in cases that the camera is not moving. Work on the application of the developed tracking mechanisms on problems related to human/computer and human/robot interaction has also been continued.

Publications MP-codes: 510, 511

5.21 Contribution by INRIA-Vista

Researchers involved: Ivan Laptev,

Activities Video Copy Detection

The aim of this collaboration is to investigate methods of sparse video representation for the task of video indexing and video copy detection. We start with the approach of space-time interest points (INRIA-VISTA) and consider its integration with the platform for video copy detection (INRIA-IMEDIA). We explore specific properties of space-time interest points in terms of sparseness and motion-sensitive local descriptors. These properties provide a basis for developing advances in video copy detection leading to storage-efficient video representation as well as accurate and fast search and retrieval of video duplicates.
More technically we investigate several directions. On the side of the interest point detector, its performance in terms of the speed and robustness might become an issue when applied to the large scale video archives. Also the existing approach to video copy detection may need to be modified to take advantage of the temporally sparse video representations. Efficient solutions for both of these problems are currently investigated. Preleminary results show both the improvements in video indexing and the possibility of real-time implementation of the proposed approach.
This activity used MUSCLE mobility grant for exchange and collaboration.

Publications MP-codes:

5.22 Contribution by

Researchers involved: Beatriz Marcotegui,

Activities Collaboration with Allan Hanbury- TU-Vienna PRIP in the framework of the E-team on "Choosing Features for CBIR and Image Annotation" on the following topics:

- Segmentation of images using the waterfall algorithm and watershed using volume extinction values on colour-texture gradients.
- Development of a segmentation evaluation approach.
- Comparison with graph-cut segmentation approach using the Berkeley segmentation data-base.
- Matching of images using 2D colour histograms.

Extensive experimentation on these topics has been done in the past 2 months, and 2 joint journal papers are under preparation.

Publications MP-codes:

6 Overview activities in WP 6

6.1 Contribution by ICCS

Researchers involved: George Papandreou, A. Katsamanis, V. Pitsikalis, P. Maragos, I. Kokkinos

Activities

Audio-Visual Interaction for Speech Recognition
Research into this field aims at improving the performance of automatic speech recognition systems in noisy environments by exploiting speech-related information extracted from video depicting the speaker's face. Audio-visual speech recognition, besides being an important research field in itself, serves as a major test-bed for methods and algorithms for cross-modal interaction potentially applicable to other multimedia integration scenarios. Part of our research on Audio-Visual speech recognition is done in collaboration with the TSI-TUC team.
We have been developing an integrated audio-visual speech recognition system. The visual front-end is based on statistical shape and appearance generative models, which track the speaker's shape and capture speech-related information into a compact set of visual speech features. As part of the visual analysis work in the above on-going research we have also developed a statistically motivated scheme for enabling the synergy between object recognition and image segmentation with application to the problem of speakers face detection.
The visual speech features are combined with auditory features and enhance the performance of speech recognition systems; the improvement is most profound in low audio SNR environments. Training of the models and audiovisual ASR recognition experiments have been conducted on the CUAVE audiovisual speech database (obtained from Clemson University).
Our research in the field has focused on adaptive methods for fusing the audio and visual modalities. We have shown that if the speech degradation under noise is explicitly modelled and the uncertainty of the features is properly taken into account, fully adaptive weighting of the two modalities can be achieved and the performance of the system significantly improves. We have also extended this framework to generalized sequence models which can account for the asynchrony between audio and visual modalities, such as Product HMMs (P-HMM) and Asynchronous HMMs (A-HMM), obtaining further improvements.
While in our earlier research we had focused in the incorporation of feature uncertainty in decoding/classification rules only, in our latest research during the reporting period we have extended our approach to statistical multimodal learning, as well. Specifically, we have shown how conventional multimodal learning rules based on the Expectation-Maximization (EM) algortihm for Gaussian Mixture Models (GMMs) and HMMs should be modified when features in the training set are only known with limited precision. This introduces new interesting feature regularization and cross-modal interaction phenomena during model training and leads to more robust and better able to generalize models, particularly in the case of few available training data.

Publications MP-codes: 313,458

6.2 Contribution by ICCS

Researchers involved: George Evangelopoulos, K. Rapantzikos, P. Maragos

Activities

Audiovisual Attention Modeling and Salient Event Detection
Although human perception appears to be automatic and unconscious there exist complex sensory mechanisms that form the preattentive component of human understanding and lead to awareness. Considerable research has been carried out into these preattentive mechanisms and computational

models have been developed and employed to common computer vision or speech analysis problems. The separate audio and visual modules may convey explicit, complementary or mutually exclusive information around structures of audiovisual events. We focus on exploring the aural and visual sources of information for modeling attention and subsequent detection of salient (important) events. In any video sequence the two streams are processed in parallel. Based on recent studies on perceptual and computer attention modeling, we extract attention curves using features around the spatiotemporal structure of video and sounds. Audio saliency is captured by modulation-domain signal modeling and multi-frequency band features extracted through non-linear operators and energy tracking. Important audio events, e.g. speech, music, sound effects can then be identified by adaptive threshold-based detection mechanisms. Visual saliency is measured by means of spatiotemporal attention models that combine various feature cues (intensity, color, motion,...) and generate a single saliency map. Statistics are thus extracted in regions of interest obtained through segmentation of this map. Integration of audio and video attention curves is achieved by means of linear and non-linear fusion schemes resulting in a single attention curve, where events supported both from audio and video are enhanced while others may be suppressed or vanish. Event detection at this final audiovisual curve is processed in multiple scales and geometrical features such as local extrema and sharp transition points are extracted that signify the presence of important audiovisual events. The potential of intra-module fusion and audiovisual event detection is demonstrated in applications such as key-frame selection, video skimming and summarization and audio/visual segmentation.

Publications MP-codes:

6.3 Contribution by ICCS

Researchers involved: Petros Maragos,

Activities

Book on *Multimodal Processing and Interaction: Audio, Video, Text* **,**

Petros Maragos (ICCS-NTUA), Alexandros Potamianos (TSI-TUC) and Patrick Gros (INRIA-TEXMEX), Editors
The book planned will cover the thematic areas of WPs 6 and 10. It will comprise two main parts: Part A will be a comprehensive State-of-the-Art review of the area and Part B will consist of selected research contributions / chapters by Muscle WP 6/10 members. A rough tentative table of contents follows.

Part I: State-of-the-art report(s) Merge WP6/WP10 state of the art reports and update

Part II: New research directions Possible thematic areas

1. Multimodal Processing, Interaction and Understanding multimedia content
    - Audio-Visual ASR
    - Feature fusion
    - Video Analysis and Integration of Asynchronous Modalities
2. Audio-Visual Saliency
    - Audio-Visual Scene Change and Dialogue Detection
    - Audio-Visual Attention and Salient Event Detection

3. Searching multimedia content
    - Annotation of multimedia databases
    - Information retrieval for video or other multimedia databases
    - Integration of Vision + Text or Audio + Text
4. Interfaces to multimedia content
    - Multimodal dialogue interfaces
    - Eye-tracking interfaces for information retrieval
    - Mobile interfaces

Publications MP-codes:

6.4 Contribution by INRIA-Texmex

Researchers involved: Patrick Gros, Maolis Delakis, Guillaume Gravier

Activities Our work in the frame of anolis Delakis's PhD are close to their end. Manolis Delakis will defend his PhD in October. Julay and August were devoted to finalize the correspoding document. Petros Maragos from ICCS-NTUA was invited as reviewer of this thesis. In the other way, Patrick Gros was invited by Petros to be one of the three editors of a book on multimedia processing to be edited and coordinated by MUSCLE.

Publications MP-codes: 457

6.5 Contribution by FORTH

Researchers involved: Panos Trahanias, Antonis Argyros, Haris Baltzakis

Activities FORTH has continued work on the development of cross-modal human-friendly interfaces for application in mobile robotic platforms performing in public places. More specifically the work focuses on the utilization of a large variety of input (speech input, input via a touch screen, visual input from cameras, and information acquired by a large number of environment sensors) and output modalities (speech, emotion expression via a mechanical face, and robot motion) to provide a multimodal user-robot interface.

Publications MP-codes:

7 Overview activities in WP 7

No activity reported.

8 Overview activities in WP 8

8.1 Contribution by AUTH

Researchers involved: Constantine Kotropoulos, Dimitrios Ververidis

Activities Feature selection based on mutual correlation
Feature selection is a critical procedure in many pattern recognition applications. There are two distinct mechanisms for feature selection namely the wrapper methods and the filter methods. The filter methods are generally considered inferior to wrapper methods, however wrapper methods are computationally more demanding than filter methods. A novel filter feature selection method based on mutual correlation is proposed. We assess the classification performance of the proposed filter method by using the selected features to the Bayes classifier. Alternative filter feature selection methods that optimize either the Bhattacharrrya distance or the divergence are also tested. Furthermore, wrapper feature selection techniques employing several search strategies such as the sequential forward search, the oscillating search, and the sequential floating forward search are also included in the comparative study. A trade off between the classification accuracy and the feature set dimensionality is demonstrated on both two benchmark datasets from UCI repository and two emotional speech data collections.
Publications

- M. Haindl, P. Somol, D. Ververidis, and C. Kotropoulos, "Feature selection based on mutual correlation," in Proc. *11th Iberoamerican Congress on Pattern Recognition* , Cancun, Mexico, November 2006, accepted.

Report for the visit of Dimitrios Ververidis at UTIA, Prague
During the visit of D. Ververidis at UTIA between September 2 and 8, 2006, discussions were made on the technique developed in [1] with Prof. M.Haindl, Prof. J. Grimm, Prof. P. Somol and Prof. J. Novovicova. In particular, speeding-up and increasing the accuracy of feature selection methods were examined. The technique is used in the Sequential Floating Forward Selection algorithm (SFFS) but according to Prof. Somol, it can be employed to other feature selection algorithms that have already been implemented in [2]. By deriving confidence limits for the outcomes of feature selection methods, it is easier to establish which feature selection method is the most efficient.
We discussed about improvements on the joint confidence paper [3] in order to prepare a journal paper. Results in [3] indicate that classifiers should use as many features as possible. However, limitations by the number of samples reduce the number of features. Except the number of samples, there is also an effect that deteriorates feature selection performance which is called the curse of dimensionality and it has not been justified yet. We have seen in [3] that SFFS reduces its backward steps when many cross-validation repetitions are used. So, the performance of SFFS coincides with the performance of Sequential Forward Selection. We consider that this is a clue that by removing features, the performance of a classifier is not improved and therefore the classifier should use as many features as possible. A justification about the phenomenon of the curse of dimensionality is prepared in [4].
We also exchanged ideas about how to improve Expectation-Maximization algorithm to model multivariate probability density functions as mixtures of Gaussians. Our method in [5] is based on a splitting criterion for non-Gaussian components, whereas the method in UTIA is based on merging non-Gaussians by means of re-sampling.
The research topic investigated in this exchange fits the cross-section of the following eteams:

- (Former) WP8 eteam on Dimension reduction for supervised learning using feature transformation
- (Former) WP5 eteam on audio and speech processing (interest of AUTH)
- Former) WP5 eteam on dynamic texture analysis (interest of UTIA)

Mr. Ververidis like to thank MUSCLE NOE for financially supporting him to visit UTIA and Prof. Haindl and his secretary Mrs. Bosakova for the hospitality and the organization of his stay at Prague.
Releted References

1 D. Ververidis and C. Kotropoulos, "Emotion recognition based on prosody contour statistics and wrappers with low computational cost:-Part II. Theoretical Analysis," Audio, Speech, and Language Processing, submitted August 2006.

2 P. Pudil, J. Novovicov, and P. Somol, Feature selection toolbox software package. Pattern Recogn. Lett. 23, pp. 487-492, 2002.

3 M. Haindl, P. Somol, D. Ververidis, and C. Kotropoulos, "Feature Selection Based on Mutual Correlation," in Proc. 11th Iberoamerican Congress on Pattern Recognition (CIAPR), Mexico, 2006.

4 D. Ververidis and C. Kotropoulos, On justifying the curse of dimensionality in feature selection problems, under preparation.

5 D. Ververidis and C. Kotropoulos, Gaussian mixture modeling exploiting the distribution of the Mahalanobis distance for splitting components, under preparation.

Publications MP-codes: 473

8.2 Contribution by TUG

Researchers involved: Horst Bischof, Helmut Grabner, Michael Grabner, Peter Roth, Thomas Mauthner, Horst Bischof

Activities

1. The automatic initialisation for training from unlabeled data with PCA+MSER tracker was replaced with a more reliable AdaBoost approach.
2. In sports domain we did some work on skin color segmentation, tracking and multiple object particle filtering.

Publications MP-codes:

8.3 Contribution by INRIA-Ariana

Researchers involved: Ian Jermyn, Josiane Zerubia, Peter Horvath, Saloua Bouatia

Activities Saloua Bouatia, an intern in INRIA-Ariana since April 2006, has continued her work on the stability of bar shapes. This is part of our attempt to construct a phase diagram (that is, a systematization of the various possible categories of global and local minima as a function of the parameter values) for the quadratic higher-order active contour prior energy using an interaction function that decreases monotonically with distance. Such a diagram will enable the choice of parameters to achieve any one of the geometries represented in the diagram, and will thus represent a full understanding of this class of models. She is now in the last phase of this work, which is testing the theoretical stability calculations against the gradient descent code previously developed as part of Marie Rochery's thesis. Aymen El Ghoul, arriving as an intern in the Ariana group for four months beginning in October, will combine the work of Ms Bouatia on bar stability and Peter Horvath on circle stability, to construct a large part of the phase diagram.

Publications MP-codes:

8.4 Contribution by Technion-ML

Researchers involved: Shaul Markovitch, Saher Esmeir

Activities The majority of the existing algorithms for learning decision trees are greedy—a tree is induced top-down, making locally optimal decisions at each node. In most cases, however, the constructed tree is not globally optimal. Furthermore, the greedy algorithms require a fixed amount of time and are not able to generate a better tree if additional time is available. To overcome this problem, we present a lookahead-based algorithm for anytime induction of decision trees which allows trading computational speed for tree quality. The algorithm uses a novel strategy for evaluating candidate splits; a stochastic version of ID3 is repeatedly invoked to estimate the size of the tree in which each split results, and the one that minimizes the expected size is preferred. Experimental results indicate that for several hard concepts, our proposed approach exhibits good anytime behavior and yields significantly better decision trees when more time is available.

Publications MP-codes: 501

8.5 Contribution by Technion-ML

Researchers involved: Shaul Markovitch, Nela Gurevich, Ehud Rivlin

Activities Submit a concise description of your WP activities. (You can use simple HTML tags to structure your text.) Assume that we are trying to build a visual recognizer for a particular class of objects—chairs, for example—using existing induction methods. Assume the assistance of a human teacher who can label an image of an object as a positive or a negative example. As positive examples, we can obviously use images of real chairs. It is not clear, however, what types of objects we should use as negative examples. This is an example of a common problem where the concept we are trying to learn represents a small fraction of a large universe of instances. In this work we suggest learning with the help of emphnear misses—negative examples that differ from the learned concept in only a small number of significant points, and we propose a framework for automatic generation of such examples. We show that generating near misses in the feature space is problematic in some domains, and propose a methodology for generating examples directly in the instance space using emphmodification operators—functions over the instance space that produce new instances by slightly modifying existing ones. The generated instances are evaluated by mapping them into the feature space and measuring their utility using known active learning techniques. We apply the proposed framework to the task of learning visual concepts from range images. We examine the problem of defining modification operators over the instance space of range images and solve it by using an intermediate instance space—the emphfunctional representation space. The efficiency of the proposed framework for object recognition is demonstrated by testing it on real-world recognition tasks.

8.6 Contribution by Technion-ML

Researchers involved: Shaul Markovitch, Saher Esmeir

Activities Most existing decision tree inducers are very fast due to their greedy approach. In many real-life applications, however, we are willing to allocate more time to get better decision trees. Our recently introduced LSID3 contract anytime algorithm allows computation speed to be traded for better tree quality. As a contract algorithm, LSID3 must be allocated its resources a priori, which is not always possible. In this work, we present IIDT, a general framework for interruptible induction of decision trees that need not be allocated resources a priori. The core of our proposed framework is an iterative improvement algorithm that repeatedly selects a subtree whose reconstruction is expected to yield the highest marginal utility. The algorithm then rebuilds the subtree with a higher allocation of resources. IIDT can also be configured to receive training examples as they become available, and is thus appropriate for incremental learning tasks. Empirical evaluation with several hard concepts shows that IIDT exhibits good anytime behavior and significantly outperforms greedy inducers when more time is available. A comparison of IIDT to several modern decision tree learners showed it to be superior.

Publications MP-codes: 502

Publications MP-codes: 503

8.7 Contribution by Technion-ML

Researchers involved: Shaul Markovitch, Evgeniy Gurevich

Activities When humans approach the task of text categorization, they interpret the specific wording of the document in the much larger context of their background knowledge and experience. On the other hand, state-of-the-art information retrieval systems are quite emphbrittle—they traditionally represent documents as bags of words, and are restricted to learning from individual word occurrences in the (necessarily limited) training set. For instance, given the sentence "Wal-Mart supply chain goes real time", how can a text categorization system know that Wal-Mart manages its stock with RFID technology? And having read that "Ciprofloxacin belongs to the quinolones group", how on earth can a machine know that the drug mentioned is an antibiotic produced by Bayer? We propose to enrich document representation through automatic use of a vast compendium of human knowledge—an encyclopedia. We apply machine learning techniques to Wikipedia, the largest encyclopedia to date, which surpasses in scope many conventional encyclopedias and provides a cornucopia of world knowledge. Each Wikipedia article represents a emphconcept, and documents to be categorized are represented in the rich feature space of words and relevant Wikipedia concepts. Empirical results confirm that this knowledge-intensive representation brings text categorization to a qualitatively new level of performance across a diverse collection of datasets.

Publications MP-codes: 504

8.8 Contribution by ENSEA

Researchers involved: Matthieu Cord, Gosselin Philippe-Henri, Camara Chavez Guillermo, Picard David

Activities Some of our recent work has been focused on video indexing. We participated to the Shot Boundary detection task of TRECVIV 2006 Evaluation. Our content-based retrieval system has been extended to video content: providing video segmentation into shots using classifiers and shot indexing based on machine learning. Our experiments showed very interesting and encouraging results. This work was managed by G. Camara Chavez. 2 publications related to this developpement are available MP-515 and MP-516. E. Pauwels came at ETIS Lab for a week of seminars, scientific discussions and prospective projects for future collaboration.

Publications MP-codes: 515, 516

9 Overview activities in WP 9

9.1 Contribution by CNR-ISTI

Researchers involved: Ovidio Salvetti, Patrizia Asirelli, Massimo Martinelli

Activities

- Extension of the eXist XML database to manage group of users and passwords;
- Invitation to joint the MM Sem W3C XG (Multimedia Semantics W3C Incubator Group)

Publications MP-codes:

9.2 Contribution by FORTH

Researchers involved: Panos Trahanias, Antonis Argyros, Haris Baltzakis, Manolis Lourakis

Activities During the reporting period, FORTH continued to be active in fields related to the second of the two grand challenges related to WP9 (Detecting and interpreting humans and human behaviour in videos). Emphasis was given to research related to recognition and interpretation of hand gestures for human/computer and human/robot interraction.

Publications MP-codes: 510, 511

10 Overview activities in WP 10

10.1 Contribution by UCL

Researchers involved: Fred Stentiford, Wole Oyekoya

Activities A paper entitled: Perceptual image retrieval using eye movements, has been submitted to the International Journal of Computer Mathematics. Research results are continuing to be analysed and written up.

Publications MP-codes:

11 Overview activities in WP 11

11.1 Contribution by Bilkent University

Researchers involved: Yigithan Dedeoglu, Ugur Gudukbay, Ibrahim Demir, A. Enis Cetin

Activities We continued our work on 3D human pose reconstruction. The proposed framework for pose construction works on single view video sequences. The framework starts with background estimation and the performer silhouette is extracted by using image subtraction for each frame. Then the body silhouettes are automatically labeled by using a model-based approach. Finally, the 3D pose is constructed from the labeled human silhouette by assuming orthographic projection. The proposed approach does not require camera calibration and it assumes that the input video has a static background and it has no significant perspective effects and the performer is in upright position.

Publications MP-codes:

11.2 Contribution by Bilkent University

Researchers involved: Mehmet Turkan, A. Enis Cetin

Activities Mehmet Turkan visited UPC, Barcelona, Spain for two weeks in August. He worked with Prof. Montse Pardas for human eyes detection. A joint paper is being prepared. The eyes detection method is determined from orthogonal projections obtained from wavelet transforms of human face images.

Publications MP-codes:

11.3 Contribution by INRIA-Ariana

Researchers involved: Ian Jermyn, Josiane Zerubia

Activities In response to the Middle East situation during the summer, the Muscle postdoctoral fellowship awarded to INRIA-Ariana and TAU Visual was reconfigured to start in France, and if necessary to have a shorter duration (the duration has to be cut off due to the end of the Muscle project). New advertisements have been placed. Due to the rules for hiring French nationals in France (as opposed to hiring nationals of country X in country X for any X other than France), we were forced to decline the most promising candidate we had received during the first round of advertisements. So far, we have not found a replacement. However, collaboration continues between TAU Visual and INRIA-Ariana via a continuation of the work that was begun during the visit of Tammy Riklin-Raviv a few months ago. This work contributes to the Shape Modelling e-team.

Publications MP-codes:

12 New MUSCLE Publications: Papers and Preprints

For more details, consult the MUSCLE online paper archive (www.muscle-noe.org > Research > Papers).

- **MP-222:** Louradour, Jerome; Daoudi, Khalid; Bach, Francis; *SVM Speaker Verification using an Incomplete Cholesky Decomposition*
- **MP-236:** Kotropoulos, Constantine; Moschou, Vassiliki; *Self-organizing maps for reducing the number of clusters by one on simplex subspaces*
- **MP-485:** Chen, Li; Stentiford, Fred; *Comparison of near-duplicate image matching*
- **MP-488:** Mayer, Rudolf; Lidy, Thomas; Rauber, Andreas; *The Map of Mozart*
- **MP-490:** Chetverikov, Dmitry; Fazekas, Sandor; *On motion periodicity of dynamic textures*
- **MP-491:** Sloin, Alba; Burshtein, David; *Support vector machine re-scoring of hidden Markov models*
- **MP-492:** Amiaz, Tomer; Kiryati, Nahum; *Piecewise-Smooth Dense Optical Flow via Level Sets*
- **MP-493:** Bar, Leah; Sochen, Nir; Kiryati, Nahum; *Image Deblurring in the Presence of Impulsive Noise*
- **MP-494:** Ruggeri, Mauro; Darom, Tal ; Saupe, Dietmar; Kiryati, Nahum; *Approximating Geodesics on Point Set Surfaces*
- **MP-495:** Pham, Thang; Smeulders, Arnold; *Metric tree partitioning and Taylor approximation for fast support vector classification*
- **MP-496:** Popescu, Adrian; Millet, Christophe; Moellic, Pierre Alain; Hede, Patrick; Grefenstette, Gregory; *Automatic Construction of a Grounded Multimedia Ontology of Objects to Illustrate Concepts in a Learning Process*
- **MP-497:** Ogata, T.; Christmas, W.J.; Kittler, J.; Ishikawa, S.; *Improving human activity detection by combining multi-dimensional motion descriptors with boosting*
- **MP-499:** Yan, F.; Christmas, W.J.; Kittler, J.; *A maximum a posteriori probability viterbi data association algorithm for ball tracking in sports video*
- **MP-500:** Hanbury, Allan; Targhi, Alireza Tavakoli; *A Dataset of Annotated Animals*
- **MP-501:** Esmeir, Saher; Markovitch, Shaul; *When a Decision Tree Learner Has Plenty of Time*
- **MP-502:** Esmeir, Saher; Markovitch, Shaul; *Anytime Induction of Decision Trees: an Iterative Improvement Approach*
- **MP-503:** Gurevich, Nela; Markovitch, Shaul; Rivlin, Ehud; *Active Learning with Near Misses*
- **MP-504:** Gabrilovich, Evgeniy; Markovitch, Shaul; *Overcoming the Brittleness Bottleneck using Wikipedia: Enhancing Text Categorization with Encyclopedic Knowledge*
- **MP-505:** Perner, Petra ; Salvetti, Ovidio ; , ; *Mass Data Analysis on Images and Signals, Industrial Conference on Data Mining - Workshops 2006*
- **MP-506:** Law-To, Julien; Gouet-Brunet, Valrie; Buisson, Olivier; Boujemaa, Nozha; *Local Behaviours Labelling for Content Based Video Copy Detection*

- **MP-507:** Law-To, Julien; Buisson, Olivier; Gouet-Brunet, Valrie; Boujemaa, Nozha; *Robust Voting Algorithm Based on Labels of Behavior for Video Copy Detection*
- **MP-508:** Law-To, Julien; Gouet-Brunet, Valrie; Buisson, Olivier; Boujemaa, Nozha; *Labeling Complementary Local Descriptors Behavior for Video Copy Detection*
- **MP-509:** Law-To, Julien; Gouet-Brunet, Valrie; Buisson, Olivier; Boujemaa, Nozha; *Labellisation du Comportement de Descripteurs Locaux pour la Détection de Copies Vidéo*
- **MP-510:** Argyros, Antonis ; Lourakis, Manolis; *Binocular Hand Tracking and Reconstruction Based on 2D Shape Matching*
- **MP-511:** Lourakis, Manolis; Argyros, Antonis; *Chaining Planar Homographies for Fast and Reliable 3D Plane Tracking*
- **MP-512:** Auvray, Vincent; Bouthemy, Patrick; Lienard, Jean; *Motion-based segmentation of transparent layers*
- **MP-514:** Laptev, Ivan; *Improvements of Object Detection Using Boosted Histograms*
- **MP-515:** CAMARA CHAVEZ, Guillermo; CORD, Matthieu; PRECIOSO, Frdric ; PHILIPP-FOLIGUET, Sylvie; de A. ARAUJO, Arnaldo; *Video Segmentation by Supervised Learning*
- **MP-516:** Camara Chavez, Guillermo; Cord, Matthieu; Sylvie, Philipp-Foliguet; Frdric, Precioso; de A. Araujo, Arnaldo; *Robust Scene Cut Detection by Supervised Learning*

13 Resource Tables

See next page. Notice that the WP-numbering refers to new WP-organisation as detailed in JPA3.

MUSCLE - Effort Table 12 July/August 2006

Participant	WP01a	WP01b	WP02	WP03	WP04	WP05	WP06	WP07	TOTAL
01- ERCIM	2.05							0.40	2.45
02 - CWI			0.30	1.07	0.86		1.30		3.53
03 - UCL				0.34	0.24	1.00			1.58
04 - KTH			0.10	0.85	0.66				1.60
05 - BILKENT		0.20	0.41	0.35	0.25		0.40	1.81	3.42
06 - VIENNA PRIP			0.20	2.00	1.60				3.80
07 - MTA SZTAKI			0.50	0.19	0.12		1.00	0.30	2.10
08 - UU							0.98		0.98
09 - CNR-ISTI		0.10	0.42	0.05	0.05		0.20		0.82
10 - FT									
11 - TUG		0.19	0.40	0.35	0.25		1.30		2.49
12 - UPC			0.10	0.19	0.12				0.40
13 - UFR					0.05		0.25		0.30
14 - UTIA	0.10		1.00				1.30	0.20	2.60
15 - UVA			0.20	1.00		0.4			1.20
16 - AUTH				0.22	0.14			0.30	0.66
17 - CEA			0.20	0.35	0.25	0.20			1.00
18 - TU VIENNA IFS				0.90	0.70	0.50	0.50	0.25	2.85
19 - ACV				0.10	0.04				0.14
20 - TECHNION-ML							0.20		0.20
21 - TECHNION-MM				0.16	0.10	0.38		0.65	1.29
22 - IBAI		0.11	0.33				0.67	0.22	1.33
23 - ICCS		0.14	0.10	0.02	0.05	1.20		0.20	1.71
24 - TSI-TUC		0.09	0.03			1.70	0.03	0.37	2.22
25 - ARMINES		0.10		0.35	0.25				0.70
26 - TAU-SPEECH			1.25	0.21	0.14		0.50		2.10
27 - TAU-VISUAL				1.45	1.15				2.60
28 - SEIBERSDORF			0.60						0.60
29 - TCD		0.20	2.80	0.30	0.21		4.70		8.20
30 - FORTH				0.26	0.17	0.83	0.22	1.30	2.78
31 - VTT		0.20				0.33			0.53
32 - INRIA Ariana		0.32	0.23	0.01	0.04		0.35	0.35	1.30
32 - INRIA Imedia		0.10		0.02	0.05	1.00	0.30	1.00	2.47
32- INRIA Parole		0.08	0.70	0.08	0.03			0.20	1.08
32- INRIA Tex Mex						0.93			0.93
32 - INRIA Vista		0.06	0.20	0.48	0.36	0.21	0.22	0.44	1.97
33 - GET				2.50	2.01		1.30		5.81
36 - UCAM-DENG			0.60	0.13	0.07		0.60		1.40
34 - LTU			1.30						1.30
35 - UNIS			0.19	0.04	0.05	0.45	0.19	0.73	1.65
37 - ENSEA		0.20		0.05	0.05		0.40		0.70
38 - CNRS			0.25	0.04	0.04				0.33
39 - UPS – IRIT									
40 - EC3									
41 - UPMC									
42 - NUID / UCD									
Total	2.15	2.09	12.41	14.03	10.08	8.73	15.93	8.72	74.14