Distributed coding for video services

DISCOVER

Deliverable 18

External liaisons
Final Version

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Abstract :	This deliverable reports on the external liaisons of the DISCOVER project. Especial importance is given to liaisons with image and video coding standardization bodies such as ISO/IEC JPEG, ISO/IEC MPEG and ITU-T VCEG. Contributions to these bodies are listed and briefly summarized. This deliverable is an update to D7, which was the version 1 of this document covering the activities during the first year of the project.
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1. INTRODUCTION

A external liaison is defined in this deliverable as any exchange, either presented, or proposed within well identified and specifically targeted consortia or research groups, in form of technical contributions or dissemination. In DISCOVER, such consortia and groups have been selected to be standardization committees with interest and relevant activities in image and video coding. Liaison is not defined as only from DISCOVER to outside, but also activities in standardization forums related to image and video coding, which might influence DISCOVER developments, are also included in the type of exchanges. In fact, in accordance with the Technical Annex of the project, individuals and partners were identified from the start of the project with the task of following and ensuring that such liaisons would take place in both directions. It is in this context that one of the main objectives of the DISCOVER project, in addition to research on Distributed Video Coding (DVC), has been to keep strong liaisons with those international standardization bodies involved in image and video coding. These bodies are the ITU-T SG 16, the ISO/IEC MPEG, the ISO/IEC JPEG, and the Joint Video Team (JVT). All these committees have potential interests or are considering future coding standards among which Distributed Video Coding can become and seen as a potential solution. Likewise, strong involvement from industry and researchers in these standardization committees give birth to identification of applications, and the underlying requirements and features needed for their successful deployment, which are also important for DISCOVER activities.

Liaison activities are also considered to be of great importance in order to have a strong scientific and technological impact, to open new prospects for IST and to contribute in solving societal problems in the longer term.

Obviously, in addition to standardization bodies, liaisons with relevant EU projects and DVC researchers in Europe and worldwide are also of paramount importance and adequate exchange mechanisms were developed within DISCOVER to also create appropriate channels for this type of liaisons.

This document is the final version of an earlier deliverable D7, which covered the external liaison activity of DISCOVER during its first year. As such, it covers all external liaison activities during the our project.

D18 is organized as follows: in Section 2, ISO/IEC MPEG activities related to DVC are described and DISCOVER contributions are presented. In Section 3 and Section 4, liaisons of DISCOVER to VCEG and JVT are described respectively. Section 5, outlines liaisons to JPEG. In Section 6, other liaison activities beyond those with standardization bodies are presented. Concluding remarks are finally given in Section 7.

2. MOTION PICTURE EXPERTS GROUP – MPEG

Motion Pictures Experts Group (MPEG) formally known as ISO/IEC JTC1 SC29/WG11 is one of the most active standardization groups in the field of audiovisual representation and coding. DISCOVER partners have been very active in this working group since very long and continue to be active there. Contributions of DISCOVER partners to MPEG during the first year, and as reflected in D7 during the first year of the project concentrated on creating appropriate and adequate links to allow the DISCOVER consortium to become aware of relevant activities within MPEG to the objectives of our project. At the same time, efforts were also made in order to prepare the ground for a possible video compression standard based on technologies and ideas that are taking shape within DISCOVER. During the second year of the project, in addition to the above, particular efforts were devoted to not only to continue to inform DISCOVER partners of developments of MPEG relevant to our project, but contributions in forms of requirements and application scenarios were made to MPEG to also inform the video coding community and their users of the potentials of Distributed Video Coding.

Among various activities within MPEG, three were identified in the first year of DISCOVER as directly relevant to the objectives and activities of our project:

- Application scenarios and requirements
- Multiview Video Coding (MVC)
- MPEG workshops on future directions in video compression

A description is provided below summarizing the details of efforts made within the context of the DISCOVER project.

During the second year, the focus of the liaison with MPEG evolved mainly around the following topics:

- Multiview Video Coding (MVC)
- Error resilience

Multiview Video Coding (MVC) was the continuation of the activities of the first year and error resilience has been an activity started in the second year.

2.1 DVC application scenarios and requirements

One of the objectives of DISCOVER is to find out which are the most promising scenarios for DVC. During the first year of the project, the consortium had produced, and submitted to the Commission, Deliverable D4 entitled *Application Scenarios and Functionalities for DVC* where the application scenarios for which DVC may bring major benefits have been described after detailed analysis. As this Deliverable may have a strong impact on future developments of DVC, Professor Riccardo Leonardi from UNIBS, on behalf of the DISCOVER consortium presented the following contribution to MPEG in a joint Requirements/Video session:

MPEG 13458, “Distributed Video Coding: Identifying Promising Application Scenarios”, Klagenfurt, 17–21 July 2006.

As outlined in deliverable D7, the main goal of this contribution was to inform MPEG by reporting on the study made by the European project DISCOVER about the application scenarios for which the DVC paradigm may bring major benefits and identify which are these benefits. Note, it is not the purpose of this contribution to claim that DVC is the right way to go for any application scenario. Considering the far from mature stage of DVC research, it is too early for

final conclusions and claims. The purpose is rather to identify the most promising applications, helping the researchers to focus their work on the most adequate application spots, in order to draw appropriate conclusions on the value of DVC.

The MPEG Requirements subgroup reacted to this contribution by impressing its appreciation that these reports on new application environments and associated needs are brought to the attention of MPEG. Professor Fernando Pereira, from IST, and the chair of the MPEG requirements, as well as Professor Joern Ostermann from UH, and Professor Touradj Ebrahimi from EPFL, all active participants to MPEG standardization committee, continued this task during the second year of the project.

As a conclusion one can state that thanks to this liaison there is currently full awareness within the MPEG committee about the applications scenarios for which DVC can be a potential solution. However, the MPEG committee is not yet in a position to initiate new standardization effort around a new video compression scheme to which DVC can be contributed. On the other hand, the deliverable D19 entitled "Applications scenarios and functionalities for DVC – final version" could benefit from the result of the exchanges with the MPEG committee in this space.

2.2 DVC multiview video coding

Multiview video coding in MPEG goes back to the period when the MPEG-2 standard was enhanced with a profile on multiview coding in order to cope with stereo and other multiview content. Later on, and with the increasing availability of sensors, displays and content capable of multiview features, MPEG started an exploration activity under the label '3DAV' in order to assess the needs, requirements and technologies for a potential new standard in this field.

Since October 2003, several efforts were made and various calls for evidence, requirements, and technologies were issued with many feedbacks received. The last call for technologies in MVC (Multiview Video Coding) was issued at the 74th MPEG meeting in Nice, France, in October 2005, and responses were evaluated at 75th MPEG meeting in Bangkok, Thailand, in January 2006. As a result, several Core Experiments in MVC were set up in order to improve various components of multiview video compression, a reference software was created, and the first multiview verification model describing a complete multiview codec was designed.

The core of the multiview coding algorithm retained for standardization in MPEG is an extension of the well-known AVC algorithm (MPEG-4 Part 10 also known as H.264 by ITU-T) where appropriate tools have been added to cope with predictions between different views and their corresponding modes, illumination compensation, etc. As of the 77th MPEG meeting in Klagenfurt, Austria, in July 2006, MPEG decided to appoint the Joint Video Team (JVT) to be responsible for standardization of MVC. The resulting standard will therefore become not only an ISO standard, but also an ITU-T recommendation.

The major difference between MVC dealt with in MPEG (now JVT) and DISCOVER resides in the fact that DISCOVER Distributed Video Coding does not require that all the cameras communicate with each other when compressing the video data, which is the case with the current MPEG-MVC. The DISCOVER project can therefore play an important role by showing to the MPEG delegates and researchers a multiview DVC approach which brings a clear and tangible added value to what is being pursued there.

Beside the input from DISCOVER to MPEG, it is important to mention that MPEG activities in MVC have also played an important role in the way DISCOVER project has and continues to plan its research activities. A large portion of the multiview test material used today within DISCOVER has been gathered thanks to contacts established inside MPEG with experts active

in this field. In addition, the Core Experiments and some of the ideas used in MPEG MVC influenced the coding approach used in DISCOVER by bringing in ideas that seemed efficient for MVC coding. Among such ideas one can mention the illumination compensation between various views.

Thanks to the liaison with MPEG on the topic of multiview video coding, it was possible to not only benefit from the various tools and experience developed in multiview processing also for DISCOVER multiview software, but also to have a clear understanding of the benefits of the use of DVC in a multiview context. In fact, it is now increasingly clear that the solution brought by MPEG MVC is potentially more appropriate for applications such as capture in entertainment scenarios where the compression gain could be during the storage and not the transmission, where as a multiview DVC approach can be used for applications such as video surveillance where a compression can be performed also at the level of each camera, without a need to communicate any information between the latter.

Another important benefit of the liaison with MPEG MVC has been the possibility to use the MPEG MVC reference software as a reference for comparisons with DISCOVER multiview software. The results are reported in the appropriate deliverable D20 entitled “DISCOVER evaluation results”.

2.3 Error resilience

MPEG has been always very active on studying the effect of transmission errors into the transmitted video stream. It has been then natural for the DISCOVER project to explore some promising benefits derived by the use of DVC for error resilience to channel errors and to inform MPEG about these activities. As this issue may have a strong impact on future developments of DVC, UNIBS, on behalf of the DISCOVER consortium, presented the following contribution to MPEG:

MPEG M14468, “Distributed Video Codec behaviors in Presence of Transmission Errors”, Riccardo Leonardi, Claudia Tonoli, Pierangelo Migliorati, Nicola Adami, San Jose, 23–27 April 2007.

A detailed analysis of the error resilience properties of a video coding system based on the DISCOVER architecture has been presented in this contribution. The behavior of such codec in presence of channel errors, first focusing on the effect of such errors on the different parts of the encoded stream have been analyzed. A preliminary comparison with H264 has been also made.

2.4 MPEG workshops on future directions in video compression

MPEG is among the standardization groups that can be qualified as pro-active. In fact, during its history, MPEG has not only responded to a need expressed by the industry or a market to establish a standard, but more than often, has predicted and initiated standardization activities in view of a possible need which would soon arise. Establishment of exploration activities such as 3DAV is such an example. MPEG also constantly assesses the performance of its standardized specifications against the state of the art.

MPEG workshops on future directions in video compression were established to contribute to the objectives mentioned above. DISCOVER partners have played a successful role in the organization and success of the MPEG workshops, even when the scope of such workshops have gone beyond that of DISCOVER objectives alone.

Professor Touradj Ebrahimi, and Professor Joern Ostermann, two of the partners of the project are among the organizers of these workshops, together with Dr. T.K. Tan and Dr. Andy Tescher. In a way it can be said that the DISCOVER partners represent Europe's view, whereas the two others each Asia and North America, respectively.

The Second MPEG Workshop on Future Directions in Video Compression was organized in Nice, France, prior to the 74th MPEG meeting in October 2005. Thanks to DISCOVER consortium which could meet well before the official start of the project in September 2005, a presentation could be planned on Distributed Video Coding, as a potential technology to be considered as a future MPEG specification. The task of presenting such a topic was given to Professor Fernando Pereira another partner of the DISCOVER project, who kindly accepted the invitation and performed a very successful presentation at the workshop. It is important to mention that the presentation was also a first occasion, already in October 2005 and only two months after the start of the project, to mention to MPEG community made of international experts in video coding, of the existence of the DISCOVER consortium, and hence to be irrevocably associate the project with advanced research in Distributed Video Coding.

3. VIDEO CODING EXPERTS GROUP - VCEG

Since the start of the DISCOVER project, VCEG has been looking into future video coding algorithms under an activity referred to as H.265. Currently there is no coordinated effort towards developing H.265, except some sporadic contributions. However, the group is looking at different technologies, which are evaluated in a common software platform (KTA) based on H.264. The KTA software includes improvements by a partner of DISCOVER project, Leibniz Universität Hannover, but also by France Telecom, Toshiba and Panasonic. At this point, encoder complexity is not yet part of the issues being investigated. The liaison between DISCOVER and VCEG has been ensured by Professor Joern Ostermann and the consortium has been kept up to date on regular basis of the progress of VCEG.

During the first year of DISCOVER project, it was reported in deliverable D7 that the error resilience was not yet an issue under consideration in VCEG. This situation changed during the second year of the project and since then the error resilience including the development of appropriate payload formats for streaming has become part of the tasks of VCEG. This decision opens the door for DVC techniques to be used within VCEG. But a precise timeline for the development has not yet been set by the VCEG committee.

4. JOINT VIDEO TEAM - JVT

JVT is currently working on amendments to H.264, and has nearly completed an amendment for Scalable Video Coding (SVC). Another amendment is related to Multiview Video Coding (MVC). As a result of a call for proposals by MPEG, H.264 based technology was choosen as a basis for Multiview Video Coding (MVC). Both work items are not related to DVC, but in the case of MVC many tools developed in that framework are relevant and can be adapted to a multiview DVC algorithm. In the second year of the project, DISCOVER partners involved in multiview coding and standardization continued to monitor MVC within JVT, as it was also done in the first year. In particular work was continued to adapt some of the concepts such as multiview prediction and illumination compensation to DISCOVER multiview codec. The MVC codec was also used as an anchor to compare with DISCOVER multiview codec in terms of

performance. The results of such a comparison are reported in the relevant deliverable D20 entitled “DISCOVER evaluation results”.

During the first year, it was reported in deliverable D7 that a presentation from Stanford University to JVT was based on DVC ideas. It was also reported that concepts on DVC were used in the context of error resilience in case of packet loss of H.264 packets. The results indicated slightly superior performance over classical error correction codes due to the graceful degradation in case of increasing errors. During the second year of DISCOVER, JVT decided to abandon this approach because of lack of support for industry to implement such an approach in products.

5. JOINT PHOTOGRAPHIC EXPERTS GROUP – JPEG

The Joint Photographic Experts Group (JPEG) is a joint committee of experts from ISO and ITU-T responsible for standardization of picture coding systems. Within ISO, it is formally known as ISO/IEC JTC1 SC29/WG1. DISCOVER partners have been active in this working group since a few years and continue to be active there. As in the case of MPEG, recent activities of the consortium within JPEG have been done in the framework of DISCOVER objectives and aim at creating appropriate and adequate links to allow DISCOVER members to become aware of activities of JPEG relevant to the objectives of this project. At the same time, efforts have been made in order to bring an impact of DISCOVER research activities to the JPEG community.

Among different JPEG activities done in the DVC context, during the first year of the project, and as reported in D7, two were directly relevant to DISCOVER objectives and activities:

- Advanced Image Coding (AIC)
- JPEG 2000 as a technology for non-DVC portion of DISCOVER codec

During the second year, in addition to the above items, a third item was also included as relevant to the objectives of DISCOVER project:

- JPEG System and JPEG XR

The following summarizes the details of the liaison established in JPEG within the context of the DISCOVER project, during the first year, but also some of the key contributions to this committee by DISCOVER during the second year, and the final status.

5.1 Advanced image coding

The JPEG group has been behind a number of successful standards. The most popular, JPEG is widely used in digital cameras, and the Internet. The more recent JPEG 2000 standard has been successful in other applications such as archival, video surveillance and especially digital cinema. An interesting observation is to note that JPEG 2000 has not been very successful in replacing JPEG standard in applications where it has been used, but rather has become successful in those applications where JPEG has not been deployed.

Based on this observation, and taking into account the cycles of technology innovations in compression, the JPEG committee has started new explorations in order to find if there is a need and if there are technologies reaching maturity in order to define the next generation of image

compression systems beyond JPEG 2000. This activity is referred to as Advanced Image Coding (AIC). If successful, AIC is foreseen to be ready for deployment in applications around the middle of the next decade. It is therefore important that the evaluation methodologies used in order to choose the best technologies for AIC, make use of the same content and assess features that will be used by then.

The first concrete results in terms of scopes and requirements of AIC were reported in a document at the 37th JPEG meeting in Singapore, on November 2005, and produced by the Requirements subgroup of JPEG under the leadership of Professor Touradj Ebrahimi, a partner in the DISCOVER project. Already in this document, Distributed Source Coding and Distributed Video Coding were identified as potential technologies, which could eventually respond to the needs of AIC.

Another important milestone took place during the 38th JPEG meeting in Cupertino, in March 2006, where in addition to further studies in scope and requirements, a process was identified for the possible establishment of AIC. According to this process, it is important to first define evaluation methodologies reflecting the desired features of the applications under the scope of AIC, before considering a call and assessment of technologies. A preliminary call for evaluation methodologies was therefore issued and interested parties were invited to respond to it not only with evaluation methodologies, but also with suggestions on how to finalize the call.

The 39th JPEG meeting in Perugia received two responses to this preliminary call of which one was from Professor Riccardo Leonardi another partner of the DISCOVER project. As a result of these responses, it became evident that a call for only evaluation methodologies in an abstract way is not efficient and that a number of technology examples should also be called for in order to make sure that the evaluation methodologies are not biased to a limited set of technologies such as those in current JPEG standards. The version 2 of the preliminary call produced at the 39th JPEG meeting now asks for both evaluation methodologies and AIC technology examples. DISCOVER project partners therefore contributed to this call with Distributed Video Coding as a potential technology to be considered when defining the evaluation methodologies of AIC, but also as an example of coding approach which would bring new features that have not been addressed by any past standard, but potentially useful for future multimedia applications.

DISCOVER contribution was made during the 40th JPEG meeting in Jeju, Korea, in November 2006, where besides presenting the DISCOVER project, and Distributed Video Coding, some new sets of requirements to be considered for AIC were put forward. Among such requirements, in particular the low complexity in encoding, and codec independent scalability were of particular interest to JPEG experts and were retained and reflected in a list of requirements to be considered for AIC when evaluating and calling for contributions. The JPEG committee in addition encouraged DISCOVER to bring further contributions especially in the area of codec independent scalability and with more emphasis on image compression at the appropriate moment. After discussion among DISCOVER partners, it has been planned that such a contribution would be made at the 43rd JPEG meeting in November 2007 in particular after the review and publication at the special session of the International Conference on Image Processing, ICIP 2007, of the work carried out in DISCOVER on codec independent scalable coding.

5.2 JPEG 2000 and HD Photo as a technology for the non-DVC portion of DISCOVER codec

In most DVC codecs, part of the coding strategy relies on non-DVC techniques. As an example, in the DISCOVER codec, some of the video frames are coded in Intra AVC, and transmitted to

the decoder. The DISCOVER general architecture proposes other alternatives such as JPEG 2000. A natural question concerns which of the two alternatives, among Intra AVC and JPEG 2000 is more suitable. Although a few attempts were made since summer 2005 by various researchers to answer to this question, no in-depth, extensive, and rigorous study was performed. In addition, some of the conclusions in the most recent reports on this topic seemed contradictory. During the first year of the project, as reported in deliverable D7, EPFL, a partner of the DISCOVER project, undertook a rigorous and extensive test to evaluate these two alternatives in terms of compression efficiency each provides. Several test video with various resolutions from small (QCIF) to medium (CIF) and high resolutions (4CIF) were compressed with appropriate parameters giving the best possible rate distortion characteristics for both Intra AVC, and JPEG 2000. For Intra AVC, both Main Profile and High Profile were employed. As a conclusion, it turned out that in general one can say that for medium and low resolution video, the performance of both AVC Intra Main and High profiles surpass that of JPEG 2000. The result becomes similar and even goes in favour of JPEG 2000 in higher resolution video, when compared to AVC Intra Main profile, and High profile, respectively. During the second year of the project, a more optimal choice of parameters for both JPEG 2000 and AVC intra confirmed these results. In addition, the newly announced HD Photo image compression format by Microsoft, and now submitted to JPEG for standardization under JPEG XR, as presented in both 41st JPEG meeting in San Jose, during April 2007, and in 42nd JPEG meeting in Lausanne, during July 2007, and hosted by EPFL a partner of DISCOVER were also included in an updated set of evaluation.

As a result, these efforts concluded that between AVC intra, JPEG 2000, and HD Photo, the best rate distortion performance for low and medium resolution video is produced by AVC intra, and therefore the choice of AVC intra used in the DISCOVER codec is appropriate.

6. OTHER LIAISON ACTIVITIES

DISCOVER puts a strong emphasis at IST related projects in order to optimize resources and to establish common synergies for the benefit of the European Union research strategy. During the project life of DISCOVER, the following IST projects have been identified whose video coding activities have a relationship to DISCOVER activities. For each of the related projects, objectives, results where available and demonstrations have been followed and taken into account. However, it is worthwhile mentioning that only one European project, and one national project has been identified with activities in Distributed Video Coding.

Dynamic and Distributed Adaptation of scalable multimedia conteNt in a context-Aware Environment (DANAE) http://danae.rd.francetelecom.com/. January 2004-June 2006.

DANAE proposes to address the dynamic and distributed adaptation of scalable multimedia content in a context-aware environment. Its objectives are to specify, develop, integrate and validate in a testbed a complete framework able to provide end-to-end quality of (multimedia) service at a minimal cost to the end-user. Error resilient and efficient (in terms of bitrate and required processing power in the player) coding schemes will be studied to cater for the specific constraints introduced by the existing multiplicity of networks and terminals. An application will be specifically developed and implemented on a demonstrator, to illustrate the new service concepts pioneered by the Project.

Main interest to DISCOVER:

Scalable coding systems

Error resilience and efficient coding schemes

Networked audiovisual media technologies (VISNET, VISNET-II)

http://www.visnet-noe.org/.

VISNET-I: December 2003-November 2005.

VISNET-II: July 2006-June 2009.

VISNET, and its follow-up VISNET-II aim at creating a sustainable world force of leading research groups in the field of networked audiovisual (AV) media technologies applied to home platforms. The member institutions have grouped together to set up a network of excellence with a clear vision for integration, research and dissemination plans. The research activities within VISNET will cover several disciplines related to networked AV systems and home platforms. These are: creation/coding of AV content for immersive home platforms, storage and transport of AV information over heterogeneous networks, audiovisual analysis techniques for immersive communications and audiovisual analysis techniques for immersive communications.

VISNET, and now VISNET-II are the only identified IST founded European effort with activities in Distributed Video Coding. Three partners of DISCOVER (IST, EPFL and UPC) are also members of VISNET, and now VISNET-II, and this has contributed to strong synergies with other VISNET partners, in particular with Politecnico di Milano. These synergies have resulted in common cooperation and shared publications between VISNET or VISNET-II and DISCOVER partners. As mentioned in D7, VISNET ended in November 2005 but in the context of its follow-up VISNET-II which started in July 2006, a particular effort was made to create a good coordination between DISCOVER partners and those in VISNET-II involved in Distributed Video Coding.

Main interest to DISCOVER:

Distributed Video Coding activities done by DISCOVER partners and liaisons with Politecnico di Milano.

Wireless Cameras and audio-visual seamless networking (WCAM) http://www.ist-wcam.org/. December 2003-March 2006.

The WCAM project studied, developed and validated a wireless, seamless and secured end-to-end networked audio-visual system. WCAM also focused on the technology convergence between video surveillance and multimedia distribution over the Internet. WCAM took into account real time aspects as well as security and scalability issues. The project aimed at improving state of the art technologies in each of the technological components involved in the system and combineed them. The WCAM system was installed and tested with users of both multimedia distribution and videosurveillance communities. The objectives of DISCOVER project were presented to WCAM partners and interest was expressed by Univeryity of Bristol in following the future activities of DISCOVER as this institution has an activity on Distributed Video Coding.

Main interest to DISCOVER:

Low complexity video cameras

Video surveillance applications and underlying requirements

Multimedia networking (MEDIANET) http://www.ist-ipmedianet.org/. December 2003-November 2005.

Targeting multimedia communications and audio-visual content distribution services for residential markets, MediaNet addresses new & more open possible supply chain architectures and co-operation schemes between content owners, service providers, network service providers, and personal computer and consumer electronics equipment manufacturers.

Main interest to DISCOVER:

Wireless audio-visual distribution

UK National Project on Distributed Video Coding

July 2007-June 2008.

University of Bristol has submitted a proposal on multi-view Distributed Video Coding in wireless environments to the EPSRC (the UK's engineering and physics research council), in which EPFL is listed as a collaborator. This proposal was ranked first among all first grant proposals from new academics to the EPSRC and will be funded, with an anticipated start date of July 1 2007. In particular, this grant is funding University of Bristol researchers to visit EPFL in order to strenghten the ties between the two institutions and to perform joint research activities. Topics to be investigated include the development of optimised multi-view DVC systems for multi-camera surveillance networks, and the evaluation of the error resiliency of the DVC system in an error-prone wireless network. University of Bristol and EPFL have also submitted a bid for a Royal Society International Joint project on the same topic. This proposal is still under evaluation. This grant would essentially fund the exchange of University of Bristol and EPFL researchers for longer visit in order to carry out joint research on multiview DVC.

7. CONCLUSIONS

Liaison activities have been very important and have had a great impact in the progress of DISCOVER project. Particular attention has been paid to liaison activities with standardization bodies: MPEG, JVT and JPEG and many DISCOVER partners have played a key role in these standardization bodies. Presentations have been made at both JPEG and MPEG meetings to introduce DISCOVER technical activities and results. In addition as JVT has been appointed to develop multiview coding techniques, special emphasis was devoted during the second year of DISCOVER project in following JVT developments which might influence DISCOVER research activities. In particular, the reference software for MVC as developed by JVT was used as a comparison point for assessing the performance of DISCOVER multiview codec, and the development of multiview tools took full benefit from the experience and work developed in MPEG and JVT in this area. Liaisons have been also very important with JPEG particularly in the AIC group and JPEG 2000 as a technology for non-DVC portion of the DISCOVER codec.