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R-LETTER

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Message from MMTC Chair

Dear MMTC members,

I am glad to open this new online publication, *MMTC Review Letter* (*R-Letter*), for our TC members and many of our friends who are working in the field of multimedia and communications. The past years have witnessed the great growth of *MMTC E-Letter*, another online publication under the great vision and enthusiastic leadership of Dr. Qian Zhang, the past TC Chair. Clearly the *E-Letter* has set a very high standard for its successors to follow. I would like to thank first for Dr. Zhang and the current *E-Letter* Director, Dr. Chonggang Wang and Co-Director, Dr. Kai Yang, for their hard work to maintain the high quality of *E-Letter*.

As a part of the original *E-Letter*, *R-Letter* stems from the *Editor Recommended Paper Column*, one of the most popular columns in *E-Letter* that aims to introduce latest break-through or promising new concepts and ideas in the field to our members. The Column Editor, Dr. Guan-Ming Su, has been working very hard around clock to select papers with breathtaking innovations and write reviews to introduce them to the audiences. As the column get more and more popular, large number of inquiries from our enthusiastic members with their willingness to participate or contribute start to challenge the original setting of a single column with one Editor. On the other hand, MMTC started a new campaign recently to encourage more collaboration among researchers working on different spots of the wide spectrum of multimedia communications. Under such a background, a Review Board is formed in TC to take over the task of recommending award-quality papers to our members via this *R-Letter*. Drs. Guan-Ming Su and Nabil J. Sarhan have been appointed as the Director and Co-Director of this Board. The homepage of the Review Board can be found at http://committees.comsoc.org/mmc/rletters.asp

It is worth mentioning that the *R-Letter* will also contribute to an open and transparent process for future *MMTC Best Paper Awards* selection, that is, all Award candidates will have to be reviewed by the *R-Letter* before being considered by the Award Board. This design has two advantages:

- The paper nomination is always open, so any member can nominate any papers to the Review Board anytime;
- The Award candidates are visible for all members, thus it provides more transparency for the Award selection process.

We hope this process benefits our members to recommend their own good work to a viable channel that can effectively share the ideas to all members in the community, at the mean time, we hope more award-quality work can be discovered to get the recognition that the authors deserve.

The papers that are eligible to be considered in *R-Letter* include all journal papers published in IEEE journals related to multimedia communications, as well as all conference papers published in the three MMTC fully sponsored conferences, GLOBECOM, ICC, and ICME, during the past two years. We encourage all members to support *R-Letter* by nominating high-quality work to the Review Board.

At the end, I would like to take this opportunity to remind our members to prepare your trip to attend IEEE GLBOECOM 2010 at Miami, Florida (http://www.ieee-globecom.org/) as early as possible where we have MMTC meeting already arranged during the conference. On the other hand, the IEEE ICME 2011 at Barcelona, Spain (http://www.icme2011.org/) is calling for workshop/tutorial proposals (deadline: **Oct. 15**) and calling for papers (deadline: **Nov. 29**). Please support these events that are fully sponsored by our TC.

Thanks and I wish *R-Letter* a big success!

Haohong Wang
IEEE ComSoc MMTC Chair

Message from R-Letter Director

Welcome to IEEE MMTC latest publication: Review-Letter (*R-Letter*). Extending efforts on the *Editor Recommended Paper Column* in *IEEE MMTC E-letter*, we have a separate letter to recommend papers with broaden missions. The main objectives of R-Letter are to introduce latest multimedia communication related papers published in ComSoc Sponsored Journal and MMTC Sponsored Conference to our MMTC members. We hope with this newly established R-letter, we could further stimulate research on multimedia communication related areas, and encourage researchers to submit papers to IEEE MMTC sponsored publications and conferences. To better serve MMTC members with broader technology overview, *R-letter* also presents papers recently published in other IEEE publications.

It's our great pleasure to have Drs. Cheng-Hsin Hsu, Ai-Chun Pang, Kalpana Seshadrinathan, and Vladimir Stanković serve as MMTC review board members and *R-letter* editors. In this issue, we introduce two papers on the scope of ComSoc sponsored journal: one paper on the topic of mobile ad hoc media streaming with consideration of stream size from *IEEE Trans. Multimedia*, and one paper on bandwidth estimation and joint QoS routing with link scheduling over wireless ad hoc networks from *IEEE Journal on Selected Areas in Communications*. In the MMTC sponsored conference column, one paper bringing randomized network coding with unequal error protection for scalable video over overlay networks is presented from *ICME* 2009 is recommended. In the technology spectrum, a study of subjective and objective video quality assessment published in *IEEE Trans. Image Processing* is briefed. We hope our members can benefit a lot from the introduced papers in this issue.

Last, I would like to thank all editors for their great efforts to make our first *R-letter* issue possible.

Guan-Ming Su,

Director of IEEE ComSoc MMTC R-Letter
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Toward Commercially-Viable Mobile Media Streaming over Ad Hoc Networks

A short review for "An adaptive strategy for mobile ad hoc media streaming"

Edited by Cheng-Hsin Hsu

M. Qin, and R. Zimmermann, "An adaptive strategy for mobile ad hoc media streaming", IEEE Transactions on Multimedia, vol.12, no.4 June 2010, pp.317-329.

Mobile devices such as Smartphones and tablets are getting increasingly popular, because they offer seamless connectivity via cellular networks. Recent market study [1] reveals that, among all applications, multimedia streaming consumes the most bandwidth of cellular data networks, a 35% share in the first half of 2010. The same report also indicates the bandwidth consumption of media streaming grows at a staggering rate of 92%. Cellular service providers [2, 3], therefore, have to cope with the tremendous increase of mobile data traffic by: (i) expanding their networks or (ii) offloading mobile data to other wireless networks.

One promising approach for cellular service providers is to offload mobile data over alternate ad hoc networks, which are made possible because modern mobile devices are equipped with multiple network interfaces, including WiFi and Bluetooth. To provide ad hoc streaming service among mobile peers is currently still very challenging. First, a primary concern is to ensure the complete delivery of a media object – which is often sizable – across a wireless link whose quality may be constantly fluctuating. A related issue is that in many situations receiving all the video frames is of more importance than achieving the best video quality. For example, with a video clip from a first-responder some of the quality can be sacrificed as long as the complete message is conveyed. Another challenge is posed by the modeling of a realistic wireless environment; a task which can be highly complex. In this context, traditional approaches often do not utilize the locally available information of a device in predicting future link status.

To address these problems, the authors built upon their prior work [4], which introduced a probabilistic link availability prediction model. The objective is to maximize the probability of streaming all video frames before a link breaks under dynamic network conditions. Instead of determining the minimally necessary buffer size, as was the case in the earlier study, the proposed method introduces a recursive algorithm for calculating the streaming probability between two mobile ad hoc peers. The realistic wireless communication model takes both the 802.11 Auto-Rate Fallback (ARF) mechanism and the random walk mobility model into consideration. ARF steps down the sending rate when consecutive transmission errors occur. Though implemented in 802.11 devices, it is not commonly modeled in prior work. Importantly, the proposed technique does not require any simplifying assumptions such as uniform streaming bandwidth, fixed node locations, or an infinite buffer size. Based on this model, three key factors relevant to successful wireless ad hoc streaming are identified: the available bandwidth, the buffer space and the stream size. Because the former two issues are mostly determined by the hardware and the environment, reducing the stream size is identified as the most promising parameter to improve the streaming probability.

To reduce the stream size under the proposed scheme, a novel streaming strategy is presented by applying Scalable Video Coding (SVC) [5] or Multiple Description Coding (MDC) [6]. This strategy requires the sender to regularly calculate the streaming probability by using the current network state and stream information between itself and the receiver. In order to maximize the streaming probability, the sender can selectively discard unnecessary enhancement layers if the streaming probability is below a certain threshold. Simulation results show that this strategy can improve the streaming probability by up to 60% without sacrificing significant video quality. To further improve the streaming performance, a layer retransmission scheme is applied by taking advantage of the situation that reconnection is very common in mobile ad hoc networks, especially when the service area is confined. In this scheme, the sender first sends all the video frames that the receiver is still expecting. After all the video frames are delivered, it then starts sending missing enhancement layers for all the unconsumed video frames at the receiver. Simulation results show an additional 10% increase in streaming probability by using this re-delivery scheme.

The proposed ad hoc media streaming strategy can be extended along several directions. For example, a future extension for streaming audio would be useful. Constraints of battery energy consumption should also be addressed. While ad hoc media streaming is not yet mature enough for commercial service, it gradually becomes a good, low-cost solution for cellular service providers to support the ever-growing bandwidth demands of mobile users. We envision that cellular service providers will soon leverage on the inexpensive nature of ad hoc networks for resource-intensive services such as media streaming.

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Joint QoS Design: Tackling Future Multimedia Service Support

A short review for "Available bandwidth in multirate and multihop wireless ad hoc networks"

Edited by Ai-Chun Pang

F. Chen, H. Zhai and Y. Fang, ``Available bandwidth in multirate and multihop wireless ad hoc networks,'' IEEE Journal on Selected Areas in Communications, vol.28, no.3, pp.299-307, April 2010.

"For the first time, researchers at Chalmers University of Technology in Gothenburg, Sweden, and Fraunhofer Heinrich Hertz Institute in Berlin/Technical University Berlin, have demonstrated 60 GHz broadband radio for wireless transmission of HD video data, HDTV. This opens up the possibility of using the 60 GHz band for applications requiring rapid data transfer, such as uncompressed transmission of HDTV, fast Internet access for passengers on airplanes and trains, and applications in medical technology and TV studios…" - *Science Daily (Oct. 11, 2009)* [1]

In recent years, supporting multimedia traffic in wireless networks has attracted tremendous attention. This is mainly because of the increasing popularity of wireless video applications such as video phone, mobile TV, video-on-demand, and video gaming in wireless networks. However, the tough communications environment in wireless networks makes it difficult to satisfy the quality of service (QoS) requirements for multimedia traffic. This is because wireless channel bandwidth is limited and shared by links close to each other, and interferences among links and between newly jointing multimedia traffic flows and existing ones are hard to estimate and control due to the broadcast nature.

Furthermore, multiple discrete channel rates and link adaptation are common in wireless networks. Link adaptation makes it more difficult to model a network due to different transmission distances and requirements on noise and interference for different rates. Previous work even showed that link adaptation may even decrease the network throughput, and such an example was demonstrated using the shortest path routing algorithms [2].

The authors developed a theoretical model for estimating the available bandwidth of a path by considering interference from both background traffic and traffic along the path. To exploit the potential of multiple channel rates and link adaptation, traditional independent sets and cliques [3] are then coupled with rate vectors to more accurately characterize the conflicting relationships among links in wireless ad hoc networks where time-varying link adaption is used. The authors showed that the clique constraint widely used to construct upper bounds does not hold any more when links are allowed to use different rates at different time, by demonstrating that a flow can achieve higher throughput than the upper bound provided by the widely used clique constraint with any fixed date rates over links. This is indeed a significant observation.

Motivated by this observation, the authors then extended the model to deal with the joint design of QoS routing and link scheduling in order to find a path with high available bandwidth in a network with background traffic [4]. This is a paramount task for QoS routing in supporting bandwidth-demanding multimedia traffic. To avoid the NP problem of finding all maximal independent sets over all links in a network, an efficient heuristic algorithm was proposed to quickly solve the joint design problem. The idea is to first optimize the link scheduling for existing traffic and then use the distributed QoS routing approach with newly proposed routing metrics to find a path that can efficiently utilize the available resource of the network [5].

To avoid solving the optimization problem, they also proposed several heuristic routing metrics to estimate the path available bandwidth. By considering both the impact of background traffic and interference among the traffic along the path, they showed that the proposed metrics "the conservative clique constraint" and "the expected clique transmission time" perform significantly better than the widely used ones such as the clique constraint and the bottleneck node bandwidth. Particularly, the performance from the routing metric "conservative clique constraint" is the best and deviates from the theoretical bound as small as 9.7%.

The theoretical developments for path available bandwidth problem and the joint design of QoS

routing and link scheduling indeed lay the solid foundation for the support of multimedia traffic over wireless ad hoc networks and should provide important design guidance for the crucial components such as connection admission/flow control for multimedia service support. It will definitely inspire many more follow-on works in dealing with multimedia communications over multihop wireless ad hoc networks.

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Networking Coding in Video Delivery: What does the Future Hold?

A short review for "Randomized network coding for UEP video delivery in overlay networks"

Edited by Vladimir Stankovic

N. Thomos, J. Chakareski, and P. Frossard, "Randomized network coding for UEP video delivery in overlay networks", Proc. of IEEE International Conference in Multimedia and Expo 2009, pp.730-733.

Cooperative networking is widely considered as the most promising network design technology that will drive the evolution of wireless mobile networks by increasing the throughput and distributing power consumption and cost. Nowadays when the first cooperative strategies have already been launched in wireless networks, and when cooperative networking is recognized as a definite way forward, is network coding, as the most prominent way of cooperation, closer than ever to become part of the technological drive for future mobile communications?

Practical network coding [1] via random linear coding (RLC) offers efficient and robust delivery of packetized data by encoding input packets into arbitrarily many encoded packets, each being a linear combination of the input packets over a selected finite field. In theory, RLC provides effective network resource utilization achieving multicast capacity on direct acyclic error-free network graphs.

RLC can be additionally used for error control as an alternative to traditional erasure forward error correction and ARQ schemes, offering close to capacity performance, rateless property, progressive decoding, and natural extensions to distributed cooperative network coding and processing. However, RLC performs random mixing of packets, treating all the buffered packets equally, i.e., it does not take into account the content of the packets. This is a clear limitation in video streaming where different packets contribute differently to reconstructed video quality. Indeed, in scalable video coding, for example, the encoded video stream is organized into a number of layers of decreasing importance to the reconstruction, which calls for unequal error protection (UEP) to maximize performance. The encoding process starts with the packets from the most important layer of the video stream, called the base layer, followed by gradually less important packets from the enhancement layers.

The standard RLC decoder is not able to exploit benefits of progressive video reconstruction offered by scalable coding, since it is either able to decode the entire video stream, if enough encoded packets are collected, or otherwise, completely discard the stream as non-decodable. A trivial solution is to encode separately each layer within one network coding generation, but this imposes delays and performance degradation. To make scalable video transmission with network coding efficient, several UEP RLC solutions have been recently proposed (e.g., [2-4]). These solutions achieve the UEP property using the expanding windowing (EW) approach [5]. That is, RLC is applied on the subset of the first l source layers (called the l-th window or importance class); this way, the source packets from the base layer are included in all encoded packets making them best protected, and the source packets from less important layers participate in a progressively smaller number of encoded packets, and are hence progressively less protected.

The authors focus on scalable video delivery over overlay network topologies, and assume that each network node performs EW RLC over its buffered packets, which are either source packets or the packets received from its parent nodes. Each encoded video GOP represents a separate generation. A child node requests packets from its parents before encoding them.

The key problem discussed in this paper is the selection of the rate allocation between classes so that the reconstructed video quality is maximized, given channel loss characteristics, bandwidth constraints and utility value of each packet (the decrease in reconstructed video distortion if the packet is decoded). The main contribution lies in showing that the objective function for this optimization problem has interestingly a log-concave form and designing a low-complexity greedy algorithm that rapidly finds an optimal rate allocation. The solution is distributed since each node applies the algorithm using the local knowledge and information from its neighbors.

Simulation results using H.264/SVC with three quality layers show significant performance improvements with the proposed solution compared to three traditional RLC methods that do not exploit the layered structure of the video. An interesting next direction is assessing implementation issues, such as delay and complexity.

Despite demonstrated potentials of the RLC technology, RLC is still not in commercial use. The results of this paper are an important step forward towards the employment of RLC in practical systems. Complementary hardware implementation attempts [6] demonstrate that RLC decoding can effectively be implemented on iPhones, but with small number of blocks only to avoid excessive CPU usage. MAC protocols based on RLC for mobile WiMAX [7] provide significant performance improvement compared to standard HARQ techniques.

This paper and other related recent progresses in RLC and specifically UEP RLC multimedia delivery will ensure that RLC plays a pivotal role in increasing wireless mobile networking performance via distributed, cooperative protocols. And it will be surprising if future WiMAX and LTE-Advanced releases do not exploit the benefits of RLC or a variant thereof.

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He has co-authored over 100 research papers published in peer-reviewed international journals and conference proceedings. He has been awarded or filed five patents in the area of distributed source-channel coding and video communications. He serves as an Associate Editor of the IEEE Commun. Letters. He has given research tutorials at ICC-2007, Eusipco-2008, and ICASSP-2009, and co-organized special sessions at MobiMedia-2009 and ICME-2010 on distributed video and multimedia over DVB, respectively.

Seeing Video Quality Through the Human Eye: Measurement and Prediction

A short review for "Study of Subjective and Objective Quality Assessment of Video"

Edited by Kalpana Seshadrinathan

K. Seshadrinathan, R. Soundararajan, A.C. Bovik and L.K. Cormack, "Study of subjective and objective quality assessment of video," IEEE Trans. on Image Processing, vol.19, no.6, pp.1427-1441, June 2010.

Digital video pervades the lives of people today, with digital video being acquired, processed and consumed by people on laptops, tablets, Netbooks, mobile handheld devices, large screen televisions, digital cinema and vehicle entertainment systems. The ease of sharing digital video via online streaming, social networking websites and video sharing sites has led to a rapid and growing proliferation of digital video applications. In addition to video proliferation in the consumer electronics and entertainment space, digital video is increasingly being used in other areas such as health, education, surveillance and security.

The ultimate standard of performance for any application that targets a human end-user can only be the quality of experience derived by the human. The reader has perhaps experienced annoyances due to the poor quality of a YouTube video or appreciated the improved visual quality of High Definition (HD) video. The human eye-brain system is a complex visual pathway that processes the visual information that is captured by the eye and enables a human observer to make these judgments regarding the quality of a video they are watching. Perceptual video quality assessment (VQA) algorithms attempt to predict the perceptual quality of a digital video, as seen by an average human observer. The application realm of VQA algorithms in any video processing system that targets a human end user is enormous, ranging from acquiring the video to the eventual display of the video. VQA algorithms are valuable tools in benchmarking and performance evaluation of video processing systems, allow service providers to encode and create content that meets specified quality requirements and can be used to optimize video communication systems for visual quality.

Ground truth data from large scale human studies are required to assess the performance of a VQA algorithm in matching human predictions of quality. This paper presents the results of such a human study and the resulting publicly available database of videos known as the LIVE Video Quality Database [1]. The LIVE Video Quality Database contains 150 distorted videos, obtained from ten uncompressed reference videos of natural scenes, which were created using different commonly encountered distortion types – MPEG-2 compression, H.264 compression and simulated transmission of videos over lossy wireless and IP networks. The distorted videos for each category in the database were chosen carefully to challenge and effectively benchmark objective VQA algorithms. Each video was assessed by 38 human subjects in a large human study and the mean opinion scores (MOS) for each video were computed.

The paper also evaluates the performance of several state-of-the-art, publicly-available full reference VQA algorithms on the database. Algorithms tested in the study include Peak Signal to Noise Ratio (PSNR), VQM from NTIA that is standardized by ANSI/ITU [2] and the recently developed MOVIE index, which incorporates a biologically plausible model of visual motion processing [3]. The study dramatically establishes the poor performance of PSNR as an indicator of human subjectivity and shows that the PSNR is highly unsuitable for use as a predictor or optimizer of video quality. The MOVIE index emerges as the algorithm with the best overall performance and is shown to be statistically superior to all other algorithms tested in the study. Two algorithms (Multi-scale structural similarity and VQM) also perform well on the LIVE Video Quality Database. The public availability of the results of the study enables researchers with a tool to benchmark new methods against existing algorithms for VQA.

Today, full reference VQA algorithms are often used by content and service providers to spot-check video content offline in an unsupervised manner. With the explosion of mobile video applications, there is rising interest in knowing more about user expectations and perception of the video quality that humans are watching [4]. We envision that future video communication applications will embed VQA algorithms at

every stage of the system, from acquisition to network transmission to display, to perform in-service, real-time quality monitoring and adaptation to deliver outstanding Quality of Experience (QoE) to consumers. Many of the VQA algorithms are inspired by and build upon knowledge of the functioning of the human visual system (HVS). The success of biologically inspired algorithms such as MOVIE in effectively predicting visual quality is validated in this paper. In studying video quality, "knowing your customer" translates to knowing and understanding the incredible complexities of the HVS. Biologically motivated video processing systems and seeing video (and not just quality) through the human eye is likely to prove transformative in the digital video revolution.

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Paper Nomination Policy

IEEE MMTC R-letter welcomes review paper nomination. Any paper published in an IEEE ComSoc journal/magazine or in the MMTC sponsored proceedings: IEEE GLOBECOM, ICC and ICME, in the two years preceding the next award board's election, is eligible.

The paper nomination is always open. Paper nominations have to be sent to the IEEE MMTC Review Board Director by email. The nomination should include the complete reference of the paper, author information, a brief supporting statement (maximum one page), the nominator information, and an electronic copy of the paper when possible. Only papers published in the two years preceding the nomination will be considered.

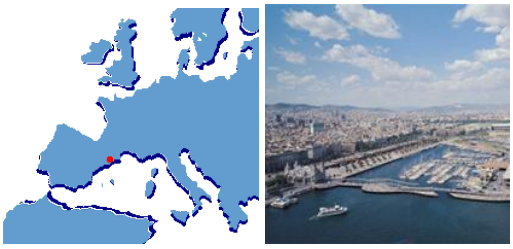
Each nominated paper will be reviewed by two members of the IEEE MMTC Review Board, according to the area of expertise, and avoiding any potential conflict of interest. The reviewer names will be kept confidential. If both members agree that the paper is of award quality, they will recommend publishing the review of the paper (partially based on the nomination supporting document) in the IEEE MMTC Review Letter.

For more details, please refer to http://committees.comsoc.org/mmc/awards.asp

IEEE International Conference in Multimedia and Expo (ICME)

http://www.icme2011.org

IEEE ICME 2011 will be hosted in Barcelona, Spain during July 11 – 15, 2011. Barcelona is a compact city, with history dates back over 2,000 years retaining major relics of its past. Barcelona has a rich cultural life all the year round: opera, ballet, concerts, theatre, festivals, exhibitions, museums, etc. These characteristics make it a unique city with a great diversity of cultural, recreational and commercial facilities. Barcelona has the dynamic and open personality so typical of Mediterranean cities. It is the only major European metropolis with five kilometers of city beachfront. Barcelona enjoys sunshine during all the seasons of the year. You can eat at open-air restaurants or enjoy a drink at any of its many pavement cafes, always on the shores of the Mediterranean.



THE HOST CITY: BARCELONA, SPAIN

Barcelona was founded over two thousand years ago, on the Mediterranean coast, between two rivers. It is located in the north east of the Iberian Peninsula, just a short distance from France. Since its beginnings, the city has been the traditional gateway to Spain. Romans, Arabs and Christians passed through it, as did the diverse cultures which came to enrich its heritage. The traces of this history and diversity can be found as you walk through the city; through its Gothic Quarter built on the Roman ruins; through its art-nouveau Eixample district, which is dominated by Gaudí's exuberant architecture, yet at the same time reveals an ordered and rational urban layout. Diversity and harmony also flourish in the character of the Barcelona people, who are enterprising and hard-working, have a hedonistic streak, and are, in particular, civic-minded and lovers of culture. These traits have made Barcelona into a first-class tourist destination and the perfect setting for meetings and congresses. This open, welcoming city shed its skin and opened up to the sea in order to host the 1992 Olympic Games and is now a modern and attractive city for tourists, business and living.

Transportation

Barcelona has excellent air links, particularly with the majority of Spanish and European cities. Its international airport, located 15 minutes from the city centre, has recently expanded with a new terminal. In 2009, it handled 27,421,682 passengers and 278,981 flight operations, and in 2010 has been awarded as the best airport in Europe. Barcelona is well connected to North America with direct flights from NY, California, Toronto and Montreal. There are also many flights every day from Asia to Barcelona.

The land transport is basically designed on a network of motorways and railway, which radiates towards the most important economic areas of the rest of Spain and connects with the French transport system to the rest of Europe.

Convenient city transportation includes metro, bus, taxi and train. There is a subway system connected from Airport to all interesting parts of the city.

Weather

Barcelona's location on the shores of the Mediterranean means it enjoys a warm climate, with pleasant temperatures all the year round.

	˚C	˚F
Jun	21	70
Jul	25	77
Aug	25	77

Congress and Conference

Barcelona is one of the cities in Europe and the world which host the greatest number of international congresses. The biggest AI conference (held once every two years) IJCAI will be held the week following ICME 2011. Also, ICCV 2011 the biggest computer vision conference will be held later on in Barcelona. Barcelona gets second position in the ICCA ranking (International Congress & Convention Association, with 135 congresses in 2009, and fifth position in the UIA (Union of International Associations) ranking for the year 2008. Leading multinationals choose Barcelona for their conventions and product presentations. Furthermore, in recent years, Barcelona has proved itself to be one of Europe's most attractive and dynamic cities, and this has made it one of the preferred incentive trip destinations.

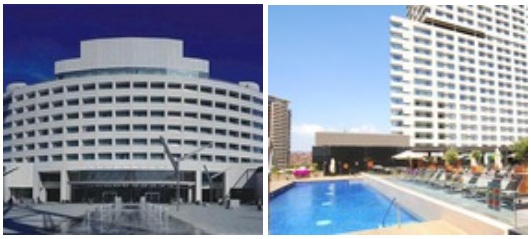
Tourism

Barcelona has a moderate weather in summer; on the sea, yet close to the mountains; has the perfect mix of museums and shopping; has thousands of affordable gourmet food from all ethnic origins; has nightlife that never stops for the young at heart; architectural masterpieces that many consider the best in the world; and is easily accessible to many other resort towns and cities nearby for people who may desire an extended holiday:

- Museums tours: Gaudi, Miro, Picasso, Contemporary Art, MNAC, Guggenheim (in Bilbao, north of Spain, 4 hours from Barcelona).
- Family tours: Zoo, Aquarium, Port Aventura (in Salou, 40 minutes from Barcelona).
- City tours: Gothic Area, Old Town area, Gaudi Tours…
- Tours to Montserrat (an exceptional Mountain 50 minutes from Barcelona) or Sitges (beautiful small sea village).

There are many affordable hotels in Barcelona, in addition to those located close to the Tourist Street of La Rambla. Many of these hotels are near a very long beach area where there is miles of beautiful walkway along the beach (Mar Bella etc.) and many in the Sagrida Familia (Magnificent Gaudi Church), Cathedral, Museum areas. If booked early rates around only $100/night is possible. Restaurants with varieties of food, Zoo, Aquarium, Port, cruises, cable car, museums, Historic Architectures … are all within walking distance in the Cathedral area.

A big part of the travelling expense is food. Barcelona has one of the best and most varied cuisines in the world. The cost of food often depends on the location of restaurants. ICME 2011 will provide a guide of affordable restaurants in various areas, where people can have excellent varieties of 3 meals a day for $40/day or so.



EMBRACE RESEARCH IN A WELCOMING CITY

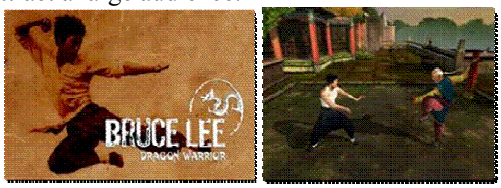
ICME has been the flagship multimedia conference sponsored by four IEEE societies since 2000. It serves as a forum to promote the exchange of the latest advances in multimedia technologies, systems, and applications from both the research and development perspectives of the circuits and systems, communications, computer, and signal processing communities. An Exposition of multimedia products, animations and industries will be held in conjunction with the conference.

ICME 2011 showcases high quality oral and poster presentations and demo sessions. Best paper, poster and demo awards will be selected and recognized in the conference. Extended versions of oral papers will be considered for potential publication in a special section of IEEE Transaction on Multimedia. ICME 2011 features IEEE societies sponsored workshops, as well as call for workshop proposals. We encourage researchers, developers and practitioners to organize workshops on various new emerging topics. Industrial exhibitions are held in conjunction with the main conference. Job fairs, keynote/plenary talks and panel discussions are other conference highlights. Proposals for Tutorials and Workshops are invited.

Conference Events

A highlight will be a tour to the state-of-the-art Medialab at LaSalle-URL, which is a unique environment of image and 3D motion capture in a single place. It combines a TV set with the classical lighting and chroma keying facilities with a 24 VICON motion capture cameras. It was opened in 2008 and is the largest of its kind in Europe.

An Exhibition area will be maintained for Industrial Displays and Expo. Industrial participants such as Digital Legends Entertainment, who specializes in the handheld and mobile market, e.g. iPad, will certainly attract a large audience.



Regular paper submission deadline:

November 29, 2010

More details are available at:
http://www.icme2011.org

We also invite corporate sponsors, whose contribution will be acknowledged according to the level of sponsorship.

"*Be our guests*"

--- ICME 2011 Organizing Committee ---