Minutes of the ArtistDesign Embedded Systems Industrial Applications Workshop

Contents

Meeting held in Rome at PARADES S.c.a.r.l. premises

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Wednesday November 12th Agenda

10:00-10:30 Welcome and agenda presentation (Alberto Sangiovanni Vincentelli and Ed Brinksma)

10:30-11:00 Energy Efficient Buildings (Michel Grabon, Carrier, Montluel)

11:00-11:30 Commissioning Systems in buildings (Roozbeh Izadi-Zamanabadi, Danfoss)

11:30-12:00 Discussion

12:00-12:30 Healthcare applications (Pierre America ESI/Philips Research/Philips Healthcare)

12:30-13:00 Printing Applications (Roelof Hamburg, ESI/formerly with Océ)

13-14:30 lunch

15:30-15:30 Embedded Systems for Automotive - the OEM perspective (Michael Borth, ESI/ formerly with Daimler)

15:30-16:00 Embedded Systems for Automotive: Challenges (Matthias Weber, CARMEQ)

15:00-16:30 Avionics Systems: Advanced Research Into Methodology for Design of Distributed Embedded Systems (Clas Jacobson, UTRC)

16:30-17:00
17:00-17:30 Coffee Break

17:30-18:00 Discussion about embedded system issues and open problems

10:15 Welcome

Alberto Sangiovanni-Vincentelli addressed the audience with the welcome speech to the workshop. ASV also presented the agenda.

10:20 Energy Efficient Buildings Presentation

Clas Jacobson from UTRC presented “Energy Efficient Buildings” in place of Michel Grabon from Carrier.

Follow up discussion

(EB): Are there indications from industry of what kind of modeling is needed? Are there clear requirements in this respect?

(CJ): You can derive these requirements from the building subsystem decomposition, but the focus should also be on the process, how you refine the requirements and increase accuracy keeping into account the coupling among subsystems.

(EB): What are the most important couplings between subsystems that are relevant to the design process?

(CJ): HVAC and ventilation systems represent a harder coupling problem with respect to lighting and material coupling. The tools are not effectively designed because of complex dynamics here and in perspective is a longer term optimization goal.

(ASV): Yes these systems are PDE with stochastic phenomena. My point is to use hierarchy and abstraction to deal with these problems.

(EB): OK it’s a tough problem, because we are coupling discrete control with complicated continuous dynamics.

(ASV): It’s complicated to analyze the dynamics, but to simplify matters, you would like to measure variables at certain points at certain times. If you could have high precision sensors you can measure the values instead of resolving the differential equations. Other problems come from how you deal with uncertainties in the implementation and emergency situations.

(PM): Could you explain what kind of tools are available and used?

(CJ): In industry we can see three stages: 1) design, 2) construction, 3) operations. There are different tool chains in the different stages. 1) tools with low fidelity kind of models; in 3) there are very few tools that do not lend themselves to control design; moreover, networks are not designed using tools today. In summary there are tools at the top abstraction levels, but tool availability decreases to nothing when you go down to lower abstraction levels.

(JM): What information can the industry share with academia to address the modeling problem?

(CJ): Interaction between academics and industry can go through public domain test beds to share modeling and infrastructure. For example, the University of California has an experimental test-bed in Berkeley and is offering to use the new Merced campus as a large test bed.

11:10 Commissioning Systems in Buildings

Roozbeh Izadi-Zamanabadi from Danfoss presented “Commissioning Systems in Buildings”.

Follow up discussion

(ASV): When you deploy the system, since the controller has been locally optimized, it does not work correctly when you put it together with other subsystems. What do you do then?

(RIZ): Use “screwdriver” to adjust solution, but since they are managed by different operators, calibration must have very simple interface.

(EB): The problem with sensor configuration and sensor failure are everywhere. What is your problem then?

(RIZ): To know if sensors are correctly connected and provide reliable information. The problem arises especially when similar sensors, such as two temperature sensors, are connected in the wrong configuration.

(CJ): There is also an issue on how you make information visible to third party. In other words, the commissioning problem is not only a technical problem because it also relates on how you make information visible.

(RIZ): The big issue is that the controller optimizes based on the information it has, so its performance depends on the configuration, which on the other hand is settled by the installers that are different people from a different group with respect to the control designers.

(EB): You can put in place some simple test and additional functionality abstracted as a Boolean model that allows you to find quickly what part is not working. In other words you need to add additional information to make the system diagnosable.

(EB): It could also relate to a procedural issue. You should put in place procedures that the installers must follow.

(RIZ): The problem is that the installer knows the procedure and does it by heart minimizing their effort and focusing only on specific delicate aspect of the installation.

12:00 Healthcare Applications

Pierre America from ESI/Philips Research/Philips Healthcare presented “Healthcare applications”.

Follow up discussion

(ASV): What kind of interactions can Philips have on this domain? Is it possible for academia to have models, problem descriptions, etc.

(PA): Not all of this stuff is publicly available. But it is possible to set up collaborations. Moreover, there are not so many models.

(ASV): Of all the problems presented here which one is the most urgent and important?

(PA): Most urgent and important refer to different issues. Performance is urgent so that on the short term academic work does not help. Evolvability, i.e., how to modify present offerings to capture technology advances is very important and Philips is trying to address it in various issues. Medical informatics on the other hand is something for the near future.

(EB): There are two important directions in healthcare: 1) going from a posteriori image interpretation to run time image elaboration (huge performance requirements); 2) creating efficient functional link in system of systems.

(ASV): The common wisdom is that integration of technologies in the system of systems view is slow to take off because of weak business model (who is paying for it?).

(EB): Contrary to consumer market is that healthcare has a very complex business model changing from country to country with governmental regulations.

(ASV): Focus of DesignArtist is the embedded system (e.g. not WSN). We need to focus on what is real today to demonstrate the work being done in the thematic clusters. For example, in the healthcare we should look at the pressing needs as drivers.

(EB): Evolvability is not very well studied in the academia because whenever academia studies something it starts creating new things, differently from industries that would like to evolve existing products and designs.

(BJ): How would you take into account the human factor into the design, for example regarding the ease-of-use requirements.

(PA): Performance is often necessary to provide fresh info to the user. The user would like push button interface that in some cases is feasible like in scanning applications. To some degree computer-based user interfaces are still reusable. You have to give the user a mental model of the system that takes time to develop, but it is not specific to the embedded system aspect.

(AF): What about security and handling of sensitive information?

(PA): The issue is there but it is not specific to the embedded system aspect. You want to be able to share medical data. What you need is “anonymization” of data to allow data sharing without compromising privacy.

(LB): Do you have project in Hyperspectral imaging.

(PA): I am not aware of that.

13:00 Printing Applications

Ed Brinksma form ESI presented “Printing applications” in place of Roelof Hamburg from ESI

Follow up discussion

(ASV): What kind of interaction do you have with the engineers in OCE’?

(EB): We do 4/5 years research projects and we insist on having a lot of interactions. Senior architects and designers are part of the project. This is hard to manage because these people represent scarce resources. Many things go under NDA, but some problems can still be presented at wider audiences.

(ASV): Do you have alternative path to mitigate risks in applying the models?

(EB): This project is not on the critical path of the company. What comes out of the project in terms of results, only then there will be a follow up technology transfer to the industry, but this is not part of the research project.

(ASV): I am trying to understand the interaction pattern of partners in ArtistDesign.

(ASV): If I do validation for the sake of validation or modeling for the sake of modeling, I don't think it is effective.

(EB): The combination of measurement and small models has been applied to accelerate development, while the creation of complete large models may impede development more than help it.

(MGH): With respect to the light weight modeling approach I would like to ask if there is a publication you can point us to.

(EB): Go to the ESI web page. Each project has a dedicated publication page. IMEC did a specific publication on on-line rescheduling for a TV system.

(ASV): We proposed VCC years ago who was based on approximate models that would not offer cycle accuracy and at that time, people refused that idea. You cannot do differently but accepting abstraction giving up accuracy if you need performance and high-level (formal) analysis.

(JM): What do you mean by light-weight modeling? The resources you spend on the model should be related to the usage of the model. The academic approach is to go to the limit of what you can go with the analytical capability of a model, while industry is more focused on calibrating the accuracy of the model just enough of what is needed.

(ASV): Just to choose the right level of abstraction is an important scientific problem!

13:45 Lunch Break

15:15 Embedded Systems for Automotive

Michael Borth from ESI (formerly with Daimler) presented "Embedded Systems for Automotive - the OEM perspective".

Follow up discussion

(L M): How do you deal with model designs that are in contrast to initial textual requirements?

(MB): This arises from the fact that initial requirements are usually based on existing products. In the case of conflicting requirements, you sit around a table with the requirement people and reinterpret the initial requirements to see if the modeling choices are correct.

(ASV): Do you see a way in which you formalize the initial textual description to capture inconsistencies?

(MB): It is tackled by introducing separation of responsibilities and using model based approach. No magic can be applied here.

(CJ): What about uncertainties for process support?

(MB): The computation about the overall population of cars in ten years of production is in principle doable but we don't know yet about effectiveness. Uncertainties about how much control you put in the door depends on design decisions based on past solutions and the limits about the solution itself.

16:00 Embedded Systems for Automotive: Challenges

Matthias Weber from Carmeq presented "Embedded Systems for Automotive: Challenges".

Follow up discussion

(EB): Is there a choice to be made between formal models and informal ones!? It shouldn't be. You should have them both.

(MW): Usually you have constrained resources and you develop only one.

(EB): Usually, informal specifications are available as initial specifications and you go for formal models tracing back to initial specifications.

(AF): What is the relation of ADL with SysML?

(MW): EAST-ADL is a software development language with some system concepts. SysML is not a software development language but a system level development language. We have been cooperating with SysML in the project, but in EAST-ADL there are mostly software concepts and a few system concepts.

(ASV): Would Carmeq be interested to cooperate with ArtistDesign group?

(MW): Yes. I would like to have some more information about ArtistDesign.

16:40 Avionics Systems: Advanced Research Into Methodology for Design of Distributed Embedded Systems

Clas Jacobson from UTRC presented "Avionics Subsystem Suppliers and Helicopters".

17:15 Discussion on ArtistDesign priorities

(PM): In ArtistDesing there is a cluster where multi-processors have been identified as a critical topic and it's pretty obvious that tools are missing there, we have to find code generation techniques for multi-processors.

(ASV): The thinking machine project thirty years ago failed and the problem were not tools but the fact that the application is difficult to parallelize. The issue is how you express concurrency. Once you have that the compiler is trivial. The key issue is that engineers failed to grasp that parallelization is an algorithmic problem, how you express your application. If you have dependencies, parallelism fails.

(CJ): The problem with avionics is that if you simplify the model you miss the application and real accurate models are all proprietary. It is very hard to talk about on what it is going on.

(LB): If I look at the picture it looks not as a large monolithic block. The problem is actually distributing an already parallelized application.

(CJ): This is because what I showed is a model drawn specifically for a tool.

(ASV): The key of the game is to tie OEM with Tier1 suppliers to extract concurrent behavior. The OEM does not know how to verify concurrent stuff so they do it sequentially.

(ASV): When you go to Matlab implementation a lot of information gets decided without knowing what will happen later. Keeping informal specifications with formal models is what we want to do so that the two levels of abstractions can be used not to lose information on design decisions that have been taken.

(ASV): It is important to maintain a link between different abstraction layers during the design process. Otherwise all the work done early in the design is lost when the final implementation is addressed and much unnecessary verification has to take place. When you take refinement decisions you must not reflect

those back to other abstraction level models because you want to be able to possibly undo your decisions if they were wrong.

(CJ): You cannot analyze a complex specification with informal specifications. If you keep going with informal specifications, than you have huge verification tasks at the back-end that you don't want.

(EB): Informal specifications are a useful complement to formal specifications, because human can quickly understand formal specification if informal versions are also provided.

(CJ): Certain parts of the business are pretty much empirical. You really choose to invest in certain parts of the system. The issue is how you structure the process. Building models for formal methods.

(LM): In my opinion it is not a question of formal or informal languages, but rather an issue of the amount of details the human mind has to deal with. Techniques for hiding details in the formal specifications would help a lot in grasping the formal specifications of our systems.

(PA): I disagree, many people like medical experts simply have difficulties in understanding formal languages. Even with UML they may find it difficult to understand.

(LM): Of course familiarity with a language is a strong enabler to prefer that language for specification purposes and unfamiliar languages are not welcome.

(PA): Many people have difficulties working with representations of the same system at different levels of abstraction.

(EB): Systems have come to a saturation in complexity where isolation is not possible any longer because subsystems have reached a level of complexity where their behavior is coupled.

(CJ): There are three different views in building automation: you need tools to capture the physics, when you capture the physics you can see the coupling of the systems. Then you need simulation models.

(ASV): We should start thinking of general recommendation on what to focus on, the flow and the tools from capture of the design to first level implementation. In the case of the building we have a very rich situation, lots of problems so that anything we do is a plus. There is a great deal of interest in the EU for zero net energy. Other topics of interests will also be coupling of mechanics with electronics, sensors, building management, etc.

(EB): What are the examples where members of ArtistDesign can fit their expertise and find synergic activities?

(ASV): The two hot topics worldwide are energy and health. Building management is important because of the energy connection. Printing is a limited application but it has been analyzed and discussed for a long time. Automotive is a strong application in Europe, is very well investigated and is a strong industrial area in Europe. Avionics is an extremely tough domain. The key is system integration, but it is very difficult to gain access to information for proprietary reasons. Consumer electronics has been left aside. The goal is to go down to two applications and see if there are synergies between these two areas.

(EB): Lighting is moving to system level issues.

(ASV): I would consider that within the building management issues. The basic idea is conjugate the energy saving with the comfort.

(AF): In the automotive the configuration issues play a big role at the system level. We need to have the capability to provide different features in different configurations.

(ASV): There is a common problem that is evolvability for variant designs in automotive, avionics and building management.

(EB): Scale is another problem in industry that is faced during the product evolution.

(ASV): There is a trend research in extensibility to make design last longer and accommodate new features without destroying the architectural platform. We have published several papers on the subject.

(EB): There is a lot of practical knowledge that has not yet been formalized to deal with evolvability. This would be a good contribution.

(ASV): We could have a big impact with modeling and verification. The validation and modeling groups will benefit from these applications.

(LB): We should set a challenge in evolvability: people doing methods and models should also add a paragraph where they say how these would scale if you double the size of the system.

18:30 Meeting Adjourned

Thursday, November 13th Agenda

9:00-9:15 Introduction

9:15-9:45 Avionics challenges (M. Winokur, IAI)

9:45-11:30 Discussion (All)

11:30-12:00 Coffee Break

12:00-13:30 Discussion (All)

13:30-15:00 Lunch Break

15:00-16:00 Conclusions and Plans

9:10 Introduction to the Second Day

Alberto Sangiovanni Vincentelli opened the second day of the workshop summarizing the discussions about Artist Design priorities and reminding the participants about the need of selecting the design driver areas at the end of the Workshop to include in the First Year report and to plan for the following years. He then introduced the speaker for the second day.

9:15 Avionics Challenges

Michael Winokur from Israeli Aerospace Industries presented "Avionics Challenges".

10:00 Discussion

(CJ): We have similar issues. Some of the needs are the same. Certification is a huge issue for us while you put it into a different part of the design chain. Another issue that is critical to us is scale and scientific ways of dealing with scale. I would also add methodology to the technology challenges that drive the tool chain.

(EB): If you want to address scalability how do you make this problem available to the academic community? What are the experimental platforms for the academia to work on?

(CJ): It's hard to make a challenge problem in the avionics. A challenge problem is one that has the same characteristic of real problems. This is instead possible in the building area.

(MWK): We came up with the UTOPAR example as a challenge problem that we are planning to share in the public domain.

(EB): This only addresses only one aspect of scalability.

(MW): In the automotive domain scalability is of a different nature than in the UTOPAR example and it is difficult to see it in this kind of examples.

(MWK): People from Carmeq are modeling the propulsion system for UTOPAR. I agree with you, but UTOPAR is meant as a common platform where you can define your own subsystems and introduce new challenges.

(MW): The core issue in the automotive industrial segment is not to build a system from scratch. This example deviates from the core problems. I think that academic should work on real industrial projects to highlight deficiencies and propose new solutions.

(EB): There are industrial challenges of many kinds. Defining challenges in which you invite people to cooperate may help. A lot of what is happening is moving to commodity market where you balance performance with price. This is not supported by these common platform examples, where the focus is on technical challenges and not on price.

(EB): In many systems we have certification issues. This is very clear in the avionics but not in the automotive.

(MWK): Insurance companies are more concerned in automotive than in avionics and aerospace because of the certification.

(ASV): Certification is a big issue for companies. Note that in certification today, it is the process to be certified (the “how” a design has been carried out) not the actual outcome of the design (the “what”). There are signs that the situation is changing so that formal techniques will be required to certify the behavior of the system not only the design process. The overall problem of validation and certification has to be addressed with a fresh look. Certification is a driver in avionics but not in the building area.

(EB): Also in healthcare we have certification.

(ASV): Industrial activities are transversal. Requirements for tools and validation are different in distinct industrial domains.

At this point, Ed Brimska took over the chair and led the discussion.

(EB): I would like to have at the end of the day a selection of two or three application domains that fulfill the ArtistDesign requirements. How do you feel about what you presented can be made common across the application domains?

(EB): ArtistDesign is a network of excellence that brings people together. As an output we can come up with a document that shows how the group activities can serve different application domains.

(MWK): There should be a document where the different outputs from the different projects (SPEEDS, COMBEST, …) are clearly summarized. This is missing.

(EB): We can build a matrix with component technologies available in the network versus the combination of these needed for the different industrial domains. Another point is to highlight topics for new projects.

(EB): What about the example presented by (RIZ)?

(PM): It looked as a very specific example that is difficult to generalize.

(JM): Maybe it can be connected with the other energy and ventilation issues in the building area.

(PM): It looks as though the example was focused on fabrication and installation issues.

(AF): But this also relates to design, that is you would like to design your system for testing purposes and robust with respect to installation issues.

(CJ): The way the problem was presented was under a narrow angle, but the big challenge is how your designs integrate with third party cooperation. This also introduces relevant design issues.

(EB): Can you say what there is in the healthcare that can be shared with other domains?

(PA): We are all dealing with complex systems that cannot be overseen by a single unit. If we change something in one corner it might interfere with a different part and the problem is discovered too late in the development process. One way to deal with that is multilevel and multidisciplinary approach. We are thinking about relatively simple models on different disciplines. The consistency among different disciplines must be guaranteed by the human. It would help if we start to look seriously in multi-disciplinary multilevel modeling to deal with complexity and unforeseen interferences among subsystems. I feel that this came out from most presentations. Taking millions of code and splitting them into parallel processors to meat temporal deadlines is also a major problem and I think that current solutions do not scale up.

(EB): Do you think that the healthcare domain could be a good driver for ArtistDesign activities?

(PA): Our projects uses healthcare domain as a driver. But it is limited to the healthcare domain alone. I see as a possibility in ArtistDesign to work on activities across different domains.

(EB): One way is to work on different domains and another is to clearly identify a core technology needed by different domains and work on that with a driver application.

(MWK): I think that cross fertilization across domains is good, specifically with the healthcare domain.

(EB): The printing application area is rather small but has many commonalities with other area. Validation is very important and the balance between resource and modeling is an important factor. In this application there are no extreme requirements such as certification, but it may be a front runner to understand where the correct balance between modeling, formalization and resources employed is. I don't think the printing area is a good driver but it provides a nice experience to make available to the ArtistDesign group.

(MWK): It may work as a good cross fertilization application area.

(EB): We pass now to the automotive application domain.

(MB): Coming up with better methods to ensure that we do not to redesign, even though we need to change. Including uncertain knowledge and uncertainties is still a research topic. Efficient embedded systems for efficiency is an important topic for the commission but has not been discussed here much.

(MW): I see some interesting overlaps. Automotive will always be under huge pressure on resources. From the engineering point of view there is not a good integration engineering environment. With respect to product lines there is a very close cooperation among suppliers in automotive. To improve their product lines become challenging because their product lines are tightly interconnected. Real industrial documents and specifications are not of high quality because done under pressure and engineers are not measured by the beauty of the models.

(EB): We should try to come up today with a selection of driving applications and plan a workshop with more specific topics. There is a number of topics common to the different domains and we can get together in a workshop and discuss these common topics specifically.

(MB): If automotive companies see the benefit they go for it.

(EB): I would like you Clas to say something about the avionics sector.

(CJ): As for the avionics sector, I restate the issue of certification. I think that verification will therefore come up in some form, thereby introducing common issues with the automotive domain.

(EB): After the break I would like the discussion to carry on not from the industrial sector standpoint by from the ArtistDesign point of view.

11:30 Coffee break

12:00 Resuming Discussion

Ed Brimska invites Jan Madsen to talk about Technical University of Denmark research activities for ArtistDesign.

(JM): Issues are about robustness of the embedded systems, for example regarding changes in the platform while executing to address new needs. We also focus on performance and energy issues for real-time

systems. The automotive domain is going to be the key driver for our research activities. We have activities related to distributed systems including wireless sensor networks. This is one of the technologies to apply to design analysis. Several institutions working in our cluster are driven by the automotive domain.

(EB): Are you interested in looking into other application domains?

(JM): Yes, we are interested in different domains, more so as they show many common issues.

(EB): Do you think that your activities in the NoE can contribute to highlight commonalities from the platform side, which is what you are bringing in?

(JM): One of the things that we are interested in and can contribute is the process of how to get to a nice parallel application that can be mapped to the platform. This issue is not clear enough yet but is critical.

(EB): Are you interested in the energy issues, which are considered hot topic in the EU.

(JM): There are two sides of it: 1) use the embedded system to control energy and 2) design the embedded system to be low power. We are looking into the latter.

(EB): How do you see the connections, commonalities and differences in what has been presented from the OFFIS point of view and the contribution that you can provide?

(BJ): We are active in CESAR where we have different application domains. Also in CESAR we try to find what is common between these application domains especially from the methodology point of view. CESAR is an opportunity that we see to provide input.

(EB): CESAR is very transport oriented with safety critical focus.

(BJ): Yes, it is very transportation oriented. CESAR fosters common activities to support the design flow in both automotive and avionics domains.

(EB): Summarizing your words, automotive and avionics are strong candidates as drivers.

(WY): We can run tasks sequentially more efficiently than the concurrent approach if you do not use resources effectively. We have contact with the Swedish car industries. This is the first time I hear about building applications, I find it interesting. I think we can contribute also in the healthcare application domain.

(PM): I am leading the cluster of software synthesis code generation and timing analysis. We are going beyond MPSOCS. We have people working on timing predictability on networked embedded systems to get upper bounds on computation. Timing is extremely important in embedded software. Although this was not mentioned in the presentations, I think this was implicit. This area is important for any safety critical applications from automotive, avionics and healthcare. I think it is extremely important. Concerning code generation, we had a workshop to understand what is really needed from the industries. Healthcare and automotive are surely domains where code generation is a key issue to derive parallel computation. We are also working on resource aware compilation. From the education point of view, I am the author of a book on embedded systems that goes beyond the embedded microcontroller. I am trying to stimulate people on the curricula issue on embedded systems design. The problem is that people tend to concentrate on microcontroller issues and do not go beyond that.

(EB): I think that the educational aspects are important and I want to keep them in the discussion and activities.

(EB): As regards the building area, how do you relate to that?

(PM): I think its issues are more on the modeling side and that there is lesser emphasis on safety, timing and MPSOCS mapping with respect to the other domains.

(PP): I would like to stress this point that PM was stating about architectural issues on timing guarantees. Timing aspects were not mentioned much in the presentations. I think that this is not only related to avionics but also to healthcare.

(MGH): I work in the operating systems cluster. Here issues regard schedulability and network middleware. In the multimedia area we found that it is necessary to give support to dynamic applications, i.e. requirements to dynamically change adding new activities in the system. This is found less in automotive and avionics, where you have static configuration that you can analyze off-line. In multimedia, we need to have dynamic on-line adaptation. We think that timing analysis should be done from the beginning of the design of the embedded systems. We have been working in the UML standard for real-time embedded systems. This is quite a young standard though. We will have to integrate that based on needs.

(EB): How do you look at the application areas that have been presented? Multimedia was not presented but maybe is an important area.

(MGH): Multimedia people are not here because here the modeling part has been stressed that they may be not so focused on today. We could establish some links with multimedia people so that they can use what we do. Dynamicity of their application is the difference with respect to other segments.

(EB): Complexity in other areas may also confront with dynamicity because they become more and more unpredictable and dynamicity may help tackle this complexity. This aspect was not very much discussed here. Summarizing, multimedia people should not be directly involved because they are not so much focused on the modeling and flow, but there are several commonalities that should be look into for common benefit.

(MGH): The timing issues seem to appear everywhere in the application domain with maybe the exception of the building area, where timing may come with softer requirements.

(CJ): In the building application there are also multimedia processing and safety and security issues that impose timing requirements.

(AF): The challenge in building is that the infrastructure is becoming big and you need to take care of the network and how the infrastructure is built.

(MGH): We can see a dichotomy here between dynamic techniques and static analysis: in the building the more dynamic techniques could be interesting, while in the avionics and automotive the static modeling and analysis are of more interest.

(SM): From IMEC we have many design groups working on different abstractions contributing to six clusters. The application domains are wireless, multimedia, biomedical, MEMS. Lately we have started also in the automotive. We would also be interested in avionics. We have a strong interest in the medical and automotive domain, but we think that also the wireless and multimedia sectors should be investigated.

IMEC would love to be able to make applications and platforms we are working on public, but there are a lot of confidentiality issues.

(EB): Of course we know that IMEC has its own agenda to find synergies between modeling and techniques across domains. We should try to benefit from this. An important point you raised is to make a list of application areas, such as wireless, that we have not addressed here, but that can influence the topics discussed here. You have also mentioned the reconfigurability issue.

(SM): From ambient intelligence and smart environment reconfigurability is a key point.

(AF): There are gaps to be filled such as requirements to system design. Other critical issues are to integrate big systems and manage complexity. On the modeling of the platform we have activities. We are interested in estimating performance. One point I didn't see is requirements on reliability, not only functional and timing. You need to take reliability into account early in the design flow. Automotive, avionics and healthcare are already considering reliability and building will soon follow as the complexity grows.

(EB): There are tradeoffs to take care in the embedded systems design. We can see this over three axes: system performance (time, energy, …), system dependability and system evolvability. Healthcare is a strong domain in Philips. Wireless and ambient are also topics of interests. I can see a connection with building. As for automotive and avionics, we only have indirect interactions with industries. We feel that we are interested in transferring knowledge from one area to another. I am also looking for partners that are willing to provide us with cases and discuss issues. I can say that automotive is very strongly represented in the Artist community.

(AF): Do you see any interaction between building and healthcare? I see that hospital have buildings with specific requirements.

(EB): The challenge there is to ask the right questions. I can see connections. There is a connection between health and building in the design of hospital. I could see connections but there are a lot of speculations. I don't know if I can make it concrete to be used in ArtistDesign.

(EB): the spectrum of healthcare is huge going from technological issues regarding diagnostic appliances to the way you organize health treatment at home, where you organize ambient technologies to assist patients at their homes.

(EB): One output I would like to have is the set of metrics to measure our activities.

13:30 Lunch Break

15:00 Final Discussion and Planned Actions

(EB): Automotive is certainly the strongest domain, but also healthcare is a promising driving application. One point is to join our research activities and see what kind of industrial problems we can address and possibly solve. We have the aim to close now. We should start out with selecting three areas as driver which should have 1) someone from ArtistDesign who could be coordinator for activities in that area and 2) some pointer in industry to make sure we have access to information to build metrics. We had 4 areas presented here. We should not try to do all of them. Should we treat automotive and avionics as two separate areas or do as in CESAR and treat them as an integrated area? We have the hospital centric healthcare and patient centric healthcare. We should plan 4 workshops: one for each area, comprising design flow and metrics in the corresponding field and a joint workshop with all to identify commonalities

among these areas. We need to identify specific requirements of the areas and common requirements to build the relevant metrics.

(ASV): We try to combine as much as possible. It would be nice to put automotive and avionics together, so the CESAR approach is my preferred way to go. As for the workshops we can co-locate the activities on the different areas in time and space so to minimize travels and to foster mutual fertilization. I totally agree that ArtistDesign is a facilitator to incubate potential other FP7 proposals.

(EB): Who has strong points for not combining automotive and avionics?

(MWK): I completely agree to combine them. For me is one of the few occasions to associate to an NoE and the exchange of ideas is very useful. Everything that ASV has said is positive. I like the idea of less travels. It is good to have people from automotive, avionics, healthcare together for mutual fertilization. There are some cross cutting technologies such as ultra reliable applications. My last point is that there is a specific supporting action about mapping the research efforts in embedded systems. It is perfect for the members of ArtistDesign to promote this.

(BJ): It is a good idea to have different domains within the same workshop that allows you to exchange ideas.

(ASV): What you would like to make sure in NoE is that people talk and make sure they are connected. You don't want to go too deep into details. The interest of application domain companies is changing and it is fundamental to let research people and people from different domains know about this and ensure they are connected. About the issue of having a single workshop with all people attending, I believe we should make sure that at least the team leaders show up.

(EB): In order to make progress we want to have some people who could prepare the picture. There is an organizational issue regarding bringing people together on the same date. We should also stress that people should present. The formal method meeting in Eindhoven on November 2009 is also focusing on having a strongly industrial meeting.

(MB): If we would focus on individual domain reducing effort can be done by combining these domain specific workshops with domain specific events.

(ASV): We should form inside ArtistDesign interest groups attached to application domains that can organize workshop as they want, but then we still have joint meetings. We can nominate coordinators for the different areas that would take care that interested people attend specific area events. Then we make sure that there are unifying events. We should write a report and a format (metrics, potential design flow, important topics) in which people from different areas can contribute.

(EB): I would like to agree on the people now. It is good that people walk out of this meeting knowing who is in charge. For energy I believe we have PARADES as the choice to lead. For healthcare ESI can be the coordinator.

(ASV): for automotive I would suggest OFFIS to coordinate. In general, I believe all groups should prepare metrics and that these metrics be discussed in relation to all industrial segments

(EB): I would be happy to try to have opinions how to organize these meetings

(ASV): One possibility is co-location with ArtistDesign plenary meeting in 2009. In addition, we can co-locate the meeting with the formal methods workshop in Eindhoven.

(EB): The good thing is that the formal method meeting is at the end of 2009, giving us time to work. So either we co-locate the workshop with the ArtistDesign plenary meeting in spring 2009 or we co-locate it with the formal methods in November. It is good that we have a first approximation how we organize the next meeting.

(ASV): Please all people indicate to which area you would like to be associated with. In the meantime we ask Bruno about the plenary meeting. What about the format of the current meeting? Do you have comments or recommendations?

(PM): For me it was absolutely OK. I got interesting impression on what industries are doing.

(EB): It would also be good for those present to advertise these meetings to the Artist community and provide feedback.

(ASV): Please send any other comments to Bruno on this meeting because they will be important for review purposes.

(EB+ASV): We would like to say to people to either send the presentation presented here if they can or sanitize them so that you can share them with the Artist community.

(ASV): Thank you so much everybody for coming.

(EB): Thank you for showing up and for your comments.

(All): Thank you for organizing.

16:00 The meeting is adjourned