

ARTES Travel Report  
**Visit to Computer Architecture Group (LRA) at  
Albert-Ludwigs-Universität of Freiburg**

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During the period from 21<sup>st</sup> November to 5<sup>th</sup> of December, I was visiting Dr. Ilia Polian and Prof. Bernd Becker from the Computer Architecture group at Albert-Ludwigs-Universität of Freiburg. The purpose of my visit was to establish research cooperation with the group, formulate joined research problems, and present my research.

### **About LRA and Albert-Ludwigs-Universität of Freiburg**

The Computer Architecture group is called Lehrstuhl für Rechnerarchitektur (LRA) in German. Previously, they used to be called Institut für Rechnerarchitektur or “IRA”, which is a little bit provocative. Their topics of research are model checking and verification, computer-aided design, testing techniques, some theoretical computer science problems, online real-time scheduling and many others. The head of the group is Prof. Bernd Becker.

Albert-Ludwigs-Universität of Freiburg is one of the oldest universities in Germany (dating to spring of early 1455), currently known the most for its medical school, research in biology, and nanotechnology (physics). Their computer science and electrical engineering departments are also well-established. The number of students in total is around 22.000 with many campuses distributed over the city of Freiburg, ranging from sociology and history to medical school (university hospital) and computer science.

### **Possible Joined Research Problems**

Initially, the topic of cooperation was formulated as “I will digest error-detection techniques and will try to incorporate them into my scheduling and design optimization frameworks”. During many discussions with Ilia, we have formulated and elaborated the following problem formulations:

1. Hardening of functional units in software/hardware co-design;
2. MPSoC (Multi-Processor System-on-Chip) hardening;
3. Integrating testing into static scheduling to increase quality-of-service;
4. Integrating testing into static scheduling to reduce power consumption.

Hopefully, many of these problems will result in conference and journal publications in the field of real-time embedded systems and low-cost fault tolerance against transient and intermittent faults.

## **Feedback to My Research**

During my visit, I gave a talk based on my licentiate thesis “Scheduling and Optimization of Fault-Tolerant Embedded Systems” and my recent research on fault tolerance for soft real-time embedded systems. The talk was appreciated and several questions were discussed afterwards. Possibly, some of my techniques will be incorporated into LRA’s work on online real-time scheduling and computer-aided design.

## **Social Activities**

Although the weather in Freiburg was not perfect, mostly raining, during that time, I was exploring the city, which is very beautiful, especially the cathedral in the middle of the city and small shopping streets. The Christmas atmosphere was already there with the Christmas market and illuminating city lights. During one of the weekends, I went to the winter opening of “EuropaPark” – the famous Deutschland Disneyland with a lot of exciting attractions represented cultural differences in Europe, including Viking Land, Russia and Switzerland. I was also in Baden-Baden, which is a very interesting city with famous thermal aqua parks, such as “Caracalla Therme” and “Friedrichsbad”. The ultraviolet-light bath, mineral water swimming pools, and various saunas helped me to recover from the Swedish late-autumn sadness.

## **Summary**

Despite the short duration, my visit was very productive with formulating several real-time research problems, which will result in conference and journal publications. I have learnt about the work that researchers in LRA had been doing on computer-aided design and testing. I have also presented my real-time research and received a positive feedback.