TU Delft

KIVI
Engineering Society

Koninklijk Instituut Van Ingenieurs

KIVI Chair
Big Data Science

Master classes

KIVI Chair - Big Data Science Master Classes

The intent of the KIVI Chair is to connect cutting edge research with knowledge developed in innovative companies. For the period of 2015-2019 the KIVI Chair will explore the topic of Big Data Science.

To establish an in-depth connection between professional engineers at a large variety of enterprises and engineers and researchers at the TU Delft, KIVI and the TU Delft Big Data Science team are organising master classes together on the following subjects:

- Transiently powered computers
- Computer graphics and visualisation
- Cyber-security

The intent of the Master Classes is for the Engineers to exchange knowledge, information and data and to inspire each other.

Program Big Data Science Master Classes

10 November 2016 - The Hague, Prinsessegracht 23

10.00	Registration
10.30	Introduction to the Big Data Science Master Classes
11.30	Master Class I,II,III
12.30	Lunch
13.30	Master Class I,II,III
16.00	Networking/drinks

For more information contact:

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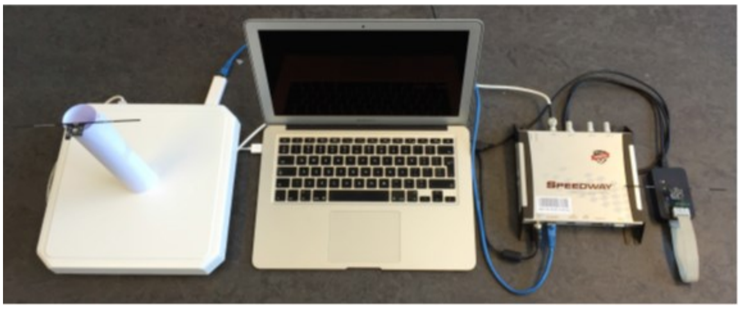
Master Class I: Transiently Powered Computers

By dr. Przemysław Pawełczak

Transiently Powered Computers (TPCs) are embedded computing machines that operate on harvested energy (for example through rectification of radio frequency radiation). TPCs attractiveness comes from the absence of manual recharge, making them “forever implantable" in any structure we can imagine. This pushes the boundaries of the Internet of Things (IoT) and enables richer data collection for the Big Data world from places still far away from the reach of classical (battery-operated) IoT devices.

In many implementations of TPCs (such as in open-source Wireless Identification and Sensing platform (WISP) [http://wisp5.wikispaces.com], see figure), communication with the outside world is performed by means of radio wave backscatter (as in the case any RFID tag). Backscatter is one of the most energy efficient communication technologies possible and the only viable communication technology for the TPCs given their low energy harvesting levels.



Because of the instability of power supply TPCs loose state every hundreds of milliseconds, preventing undisturbed computation and communication for prolonged periods of time. This eigenfunction of TPCs calls for new paradigms of thinking about systems: how to write programs that are aware of inevitable energy breakup, and how to communicate with the outside world in so minuscule power levels while being prone to high levels of interference. The goal of this module is to have a crash-course level understand on how TPCs operate, what are their applications, what are the challenges associated with them and how to simply make them usable for the IoT ecosystem.

Study Goals: To understand how battery-less energy harvesting backscatter systems work and to be able to create simple applications for them.

Master Class

- Introduction to battery-less computing
- Operation, ecosystem, frequency bands, types (active/passive, inductive/radiating)
- UHF RFID Readers: radio architecture, components
- RFID EPC Gen2 Standard: communication RFID tag/RFID reader
- LLRP protocol: communication RFID reader/PC
- WISP 5.0: hardware, software
- Application examples

Workshop

- Introduction to the class goals
- Analysis of EPC Gen2 Trace: Reader-Tag (Matlab/Octave/other type of text file plotting/importing tool needed)
- Control of RFID reader: formulating of EPC query at the reader for tag inventory (access to Internet needed, Python interpreter required)
- Programming WISP functionality: MSP Code Composer Studio required

Pre-existing knowledge required: Programming Embedded Systems (MSP430), programming in C and Python, basic understanding of electronics and radio communications.

Literature: Shyamnath Gollakota, Matthew S. Reynolds, Joshua R. Smith, and David J.Wetherall, "The Emergence of RF-Powered Computing", Computer, vol. 47, no. 1, pp. 32-39, Jan. 2014, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6671558

Master Class II: Computer Graphics and Visualization
By prof.dr. Elmar Eisemann

Computer graphics is a research field with many applications in various domains; ranging from lighting simulations for architecture, over data visualization in geology and the medical field, to special effects in movies or games. One traditional challenge is the simulation of natural scenes, including complex geometric models and a realistic reproduction of physical phenomena, requiring novel theoretical insights, appropriate algorithms, and well-designed data structures. In particular, there is a need for efficient image-synthesis solutions, which is fuelled by the development of modern display devices, which support 3D stereo, have high resolution and refresh rates, and deep color palettes.

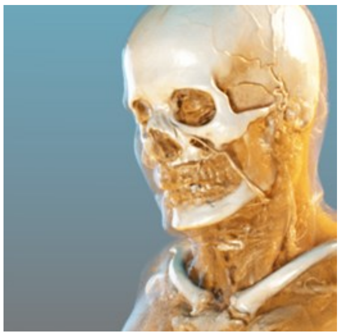
We will give insights into methods to efficiently perform image synthesis, exceeding the boundaries of current rendering techniques. Important aspects are the trade-off between performance and visual fidelity, as well as scalability to large-scale data sets (e.g., point-cloud or medical scans). Further, we show that a deeper understanding of the human visual system can be crucial in the development of rendering solutions for modern display devices. This direction opens up new possibilities and has high potential for future image-synthesis solutions.

In Depth master class on Volumetric Data Sets

This in-depth master class will cover volumetric data sets. Volumetric data is used in many contexts; physics simulations, medical data, or as a level-of-detail representation for point cloud data to name a few examples. While conceptually simple, there are a lot of exciting topics attached to this kind of data structure, which are of high practical relevance for exploration, interaction, and display. In many cases, it requires smart technical solutions to deal with the often huge amounts of information - just 2000 colored voxels along each axis amount to 32 GB of data. We will demonstrate techniques that are able to handle in some cases up to 10^15 voxels along each axis interactively.

Master Class

- Introduction to the basic representation
- hierarchical data structures
- transfer functions
- examples of typical applications
- Explore the display process
- standard techniques
- level-of-detail representations combined with stochastic rendering solutions.
- out-of-core rendering for large scale visualisation
- on-the-fly caching systems
- remote rendering solutions to perform server side evaluations
- recent compression algorithms
- drastic reduction techniques, compressing petabytes of data to a few gigabytes.



Master Class III: Cyber-security

By dr. Christian Doerr

This master class will consist of two components: first, we will look at the effectivity of cyber security strategies for organizations in face of recent USB-born malware such as StuxNet. Second, we will take a deep dive into the security of WiFi and analyze how design failures in the original WiFi protocol results in very a insecure communication ecosystem.

Organizational Security in the Times of APT malware

Traditionally, cyber and network security solutions are perimeter-based. A firewall shields the organization from outside threats, passwords on accounts and WiFi networks prevent access from unauthorized users, and networks separated into compartments stop the flow of threats throughout an organization.

The advent of recent malware such as StuxNet etc. which not only propagates through the network but also by other means such as USB storage and thus carried and propagated by people calls into question the efficacy of existing cyber security defense tools. In this talk, I will present results from a measurement study showing how this new generation of malware spreads differently within organizations and circumvents existing protection schemes. The fight against such new malware is however not hopeless, but can be efficiently combated with new means.

Protocol Design Failures - A Deep Dive into WiFi and what we can learn from it

Already a few years after the introduction of WiFi, major security flaws of this protocol became evident. In this talk, we will take an in-detail look at how this defacto standard for wireless networking works, and the fundamental assumptions and design decisions beneath it. We will then review the algorithms and design failures around the WiFi protocol in depth, and draw out conclusions on how to securely design wireless communication for future applications.

Master Class

- The next generation of malware
- New means to combat malware
- Wireless networking flaws
- Fundamental assumptions and design decisions of WiFi standard
- Review of algorithms and design failures around WiFi protocol
- Secure design for future wireless communication

The content of the Master Class has not yet been finalised. We would appreciate it if you could forward any suggestions for subjects to be included to us.