SEI-Tagung-2022 Studien-gruppe..Elektronische..Instrumentieru

Monday, March 21, 2022 - Wednesday, March 23, 2022

Book of Abstracts

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Eröffnung / **1**

Eröffnung

Author: Peter Goettlicher[1]

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test

Summary:

Sensorik / **2**

Field receiver on the -200dBc level

Authors: Frank Ludwig[1]; Matthias Hoffmann[2]; Louise Springer[2]; Uros Mavric[2]

[1] *DESY*

[2] *MSK (Strahlkontrollen)*

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In this contribution we present our investigations of carrier suppression interferometer technique for an application as an RF field reciever for Low-Level RF control systems. We will show limitations on key components, calibration methods and first results from laboratory measurments.

Summary:

Sensorik / **3**

A Handheld Pulser with Realistic Detector Pulse Shape

Author: Michael Wiebusch[1]

[1] *GSI Helmholtzzentrum für Schwerionenforschung*

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Summary:

A handheld battery powered device was constructed which employs a fast discrete analog circuit to imitate the pulse shape of a particle detector (e.g. a PMT or SiPM). The rise and decay time as well as the amplitude are adjustable. A microcontroller and a small display serve to preview the waveform for convenience. Furthermore the device can create multiple distinct energy lines at the same time by quickly alternating between different pulse amplitudes. Both positive and negative output polarity is possible.

MSR – Messen, Steuern, Regeln und Slow-Control / 4

Einsatz von EPICS für ein 1 MeV AMS

Author: Yannick Boothby[None]

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- IOC für NEC AccelNET System
- IOC für Strommessung mit JSON
- IOC für Piezo Motor Controller für bis zu 36 Motoren

Summary:

FPGA / 5

Entwicklungsinfrastruktur für MPSoc und RFSoC Plattformen

Authors: Timo Muscheid[None]; Nick Karcher[None]; Richard Gebauer[1]; Oliver Sander[1]

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Summary:

FPGAs aus der Familie der MPSoC/RFSoCs werden von uns für verschiedene Anwendungen eingesetzt, beispielsweise bei der Ansteuerung des CMS Experiments (MPSoC), der Auslese supraleitender Sensoren (MPSoC) und der Steuerung von Quantenbits (RFSoC). Der große Vorteil der MPSoC-Architektur ist, dass Algorithmen und Funktionen des Systems flexibel in Hardware- und Softwarekomponenten partitioniert werden können. Dies zieht jedoch gleichzeitig eine höhere Komplexität bei der Entwicklung dieser Systeme nach sich. In diesem Beitrag stellen wir die verwendeten Werkzeuge und unser Vorgehen bei der Entwicklung von SoC Firmware vor.
Durch Verwendung von Yocto wird die FPGA-Firmware im Rahmen des Build-Prozesses automatisch für die Zielplattform erstellt. Ferner haben wir ein System für Unit-Tests der einzelnen Firmware-Module eingeführt sowie eine Umgebung entwickelt, das automatisch komplexe H ardware/Software-Konfigurationen auf verschiedenen MPSoC-Plattformen überprüft. Die Einbindung von Messgeräten wie Oszilloskopen in die Test-Umgebung erlaubt die zusätzliche Überprüfung von DAC und ADC Schnittstellen. Mithilfe eines modularen Frameworks basierend auf gRPC (Remote Procedure Call) können wir via Ethernet mit der Plattform kommunizieren und dadurch Prozeduren auf der Plattform von externen Geräten starten sowie Registerwerte auslesen. Durch die Netzwerkanbindung der Plattform in Kombination mit den Systemen für automatisierte Firmware-Erstellung und Überprüfung konnte die kontinuierliche Integration (CI) unserer Entwicklungsinfrastruktur erreicht werden.

Datenanalyse / **6**

GPU unterstützte Datenauswertung

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Summary:

Sensorik / **7**

Parasitäre Effekte bei Strommessungen mit Shunt-Widerständen – Drei konkrete Beispiele und Vorschläge zur Kompensation

Author: Thomas Wiesner[1]

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Summary:

Datenanalyse / **8**

Reconstruction of Small-Angle X-ray Scattering data using Invertible Neural Networks

Author: Erik Thiessenhusen[1]

Co-authors: Nico Hoffmann [1]; Thomas Kluge [1]; Tom Cowan [1]; Melanie Rödel [1]; Michael Bussmann [2]

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The understanding of laser-solid interactions is important to the development of future laser-driven particle and photon sources, e.g., for tumor therapy, astrophysics or fusion. Currently, these interactions can only be modeled by simulations which need verification in the real world. Consequently, in 2016, a pump-probe experiment was conducted by Thomas Kluge to examine the laser-plasma interaction that occurs when an ultrahigh-intensity laser hits a solid density target. To handle the nanometer spatial and femtosecond temporal resolution of the laser-plasma interactions, Small-Angle X-Ray Scattering (SAXS) was used as a diagnostic to reconstruct the laser-driven target. However, the reconstruction of the target from the SAXS diffraction pattern is an inverse problem which are often ambiguous, due to the phase problem, and has no closed-form solution. We aim to simplify the process of reconstructing the target from SAXS images by employing Neural Networks, due to their speed and generalization capabilities. To be more specific, we use a conditional Invertible Neural Network (cINN), a type of Normalizing Flows, to resolve the ambiguities of the target with a probability density distribution. The target in this case is modelled by a simple grating function with three parameters. We chose this analytically well-defined and relatively simple target as a trial run for Neural Networks in this field to pave the way for more sophisticated targets and methods. Unfortunately, we don't have enough and reliable experimental data that could be used as training. So, in consequence, the network is trained only on simulated diffraction patterns and their respective

ground truth parameters. The cINN is able to accurately reconstruct simulated- as well as preshot data. The performance on main-shot data remains unclear due to the fact that the simulation might not be able to explain the governing processes.

Summary:

FPGA / 9

A fast inference platform on FPGA for the control of particle accelerators

Authors: Luca Scomparin[1]; Michele Caselle[2]; Andreas Kopmann[3]; Erik Bründermann[2]

[1] *KIT IPE*

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The required flexibility of modern particle accelerators to provide novel and exceptional beams, an increased number of operation modes, and better performance in simultaneously more compact accelerators demand advanced control methods.
In this context, machine learning algorithms are expected to find autonomously the best operating conditions. If the system under study exhibits fast dynamics, low latency inference is needed in order to perform actions in a comparable time frame.
In this talk, the preliminary development of this kind of fast inference platform based on the novel Xilinx Versal architecture will be presented. The final goal will be the integration of this system with present fast beam diagnostic instrumentation like KAPTURE and KALYPSO, developed and built at KIT, in order to use Reinforcement Learning algorithms to control microbunching instabilities at the KARA accelerator.
Finally, the KINGFISHER platform will be briefly discussed. Taking advantage of current high-level synthesis tools, the ultimate goal is to allow the programming of the full system, including the FPGA. Using only high-level programming languages like C++ and Python, might pave the way to make this platform accessible to non-FPGA experts.

Summary:

FPGA / 11

External FPGA interface for high throughput multi-channel event timers

Author: Tino Roehlicke[1]

Co-authors: Maximilian Diedrich [1]; Michael Wahl [1]; Sebastian Kulisch [1]; Torsten Langer [1]; Rainer Erdmann [1]

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The speed of modern Time-Correlated Single Photon Counting (TCSPC) requires very fast host interfaces and/or real-time data processing. We present a new instrument design with scalability for

many channels, an extremely short dead-time, 5 ps resolution and a high speed interface to one or more external FPGAs, where custom algorithms for real-time data processing can be implemented. The interface can carry a total rate of up to 1.8 Gtags/s from up to 64 synchronized input channels. It is based on open standards and can be connected to a variety of FPGAs.

Summary:

DAQ – Data Acquisition / **12**

New MicroTCA board developments at DESY

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Summary:

MSR – Messen, Steuern, Regeln und Slow-Control / **13**

Datenaufnahmekonzept mit detektornahen (“abgesetzten”) ADCs

Author: Sascha Wüstling[1]

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Im Vortrag wird ein Datenaufnahmekonzept vorgestellt, bei dem die ADCs möglichst nahe an die Signalquelle heranrücken. Die digitalisierten Daten werden serialisiert und als Rohdaten über hochratige kommerzielle LWL an eine digitale Nachverarbeitungsplattform weitergereicht.
Gerade bei Detektoren in hohem Magnetfeld und/oder auf einem Hochspannungspotential ergeben sich hierbei Vorteile.
Der Anstoß zu dieser Entwicklung ergab sich durch Anforderungen des KATRIN-Neutrinomassenexperimentes nach einer optimierten Datenaufnahme, gerade auch im Hinblick auf die Suche nach sterilen Neutrinos mit KATRIN (TRISTAN).

Summary:

DAQ – Data Acquisition / **14**

Recent DAQ Developments at DESY, FEA

Author: Tomas Vanat[1]

[1] *FE (FEA Digital Electronik)*

Corresponding Author: tomas.vanat@desy.de

The talk is an overview of new projects in the field of data acquisition systems (DAQ) that have been conducted in the FEA (Digital Electronics) Group at DESY in 2021 and early 2022. A new Zynq UltraScale+ SoC-based platform with 100Gb/s links has been a major project. Observations and issues discovered during the development and prototype testing will be discussed. The second project is a data acquisition system for a digital silicone photomultiplier (dSiPM) using Caribou, a DAQ

framework for pixel detector prototyping that has been gaining popularity among the pixel detector community recently. An overview of the Caribou system and its advantages will be shown.

Summary:

MSR – Messen, Steuern, Regeln und Slow-Control / 15

Cybersicherheit für MSR-Anwendungen

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Lokal oder global vernetzte MSR-Anwendungen lassen sich funktional dem Internet der Dinge (IoT) zuordnen. Sie sind daher einerseits inzwischen auch den gleichen Risiken möglicher Cyberangriffe ausgesetzt, wie Millionen andere IoT-Applikationen. Anderseits kann man sich hinsichtlich der Absicherung (Cybersicherheit) solcher Anwendungen aber auch an Standards und Normen wie z. B. ETSI EN 303 645 und IEC 62443 orientieren.

Der Beitrag zeigt an Hand von zwei Beispielen auf, was bei der Authentifizierung von Zugriffen und den unbedingt erforderlichen Software-Updates zu beachten ist.

Summary:

Jede vernetzte Anwendung sollte nicht nur hinsichtlich der benötigten Funktionen, sondern auch der erforderlichen Cybersicherheit konzipiert werden. Standards und Normen, wie z. B. ETSI EN 303 645 und IEC 62443 eignen sich dabei als Leitfaden.

Detektoren und Systeme / 16

MODEL-BASED CORRECTION METHOD FOR TEMPERATURE-DEPENDENT MEASUREMENT ERRORS IN EMI SYSTEMS

Author: Tazifor Martial Tchantcho Amin[None]

Co-authors: Egon Zimmermann ; Johan Alexander Huisman ; Markus Dick ; stefan van waasen ; Achim Mester

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Electromagnetic induction (EMI) is a non-invasive and fast geophysical measurement technique that provides information about the uppermost meters of the subsurface with a spatial resolution in the sub-meter range. Frequency domain EMI systems measure the apparent electrical conductivity (ECa) of the soil by inducing a time-varying primary electromagnetic field into the ground using a sender. Since the subsurface is electrically conductive, the primary field produces eddy currents that lead to the generation of secondary electromagnetic fields. The superposition of the secondary and the primary electromagnetic field is measured at a receiver, and the imaginary part of this superposed magnetic field is related to the ECa of the subsurface.
Data measured using EMI systems are known to be susceptible to measurement influences associated with time-varying external ambient factors. Temperature variation is one of the most prominent factors causing drift in EMI data, leading to poor predictive performance and non-reproducibility of results. Typical approaches to mitigate drift effects in EMI instruments are performing a temperature drift calibration where the instrument is heated up to specific temperatures in a controlled environment and the observed drifts are collected in a lookup table for a static ECa correction.
An enhanced correction method is presented that models the dynamic characteristics of drift and later uses it for correction. The model is tested with a custom-made EMI device equipped with ten

temperature sensors that simultaneously measure the internal ambient temperature across the device. The device was used to perform outdoor calibration measurements over a period of 16 days within a wide range of temperatures. In order to reduce the influences of soil variation over time, the instrument measured ECa at a height of 0.7 m with an intercoil spacing of 1.2 m. In contrast to typical approaches involving static thermal ECa error correction based on a look-up table, this new approach models the dynamic thermal characteristics of the drift and actively uses it for correction. The results are showing that modelling the dynamic thermal characteristics of the drift helps to improve accuracy by a factor of five compared to purely static characterization with a look-up table. In addition, the modelling parameters used for drift correction are very stable for all sixteen datasets. For instance, the average temperature-dependent ECa drift of about 2.45 mSm-1K-1 fluctuates only by 0.04 mSm-1K-1 between measurements for a temperature variation of about 30 ℃. These results suggested that our enhanced correction method using the modelling of dynamic thermal characteristics of EMI systems is a relevant method and beneficial for usage to improve drift correction.

Summary:

DESY - Vorstellung - I / **17**

Virtuelle Führung

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Summary:

DESY - Vorstellung - II / **18**

Plasmabeschleunigung am DESY

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Summary:

ASIC / **19**

A Simulation Framework to Optimize Signal Processing for Particle Detectors

Authors: Florian Rössing[1]; Lukas Krystofiak[2]; André Zambanini[3]; Christian Grewing[1]; Stefan van Waasen[4]

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[2] *Juelich Research Centre*

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Particle Detectors evolve to ever higher performance, both in terms of sensitivity and channel density. This increases the amount of data to be handled. As transmitting this raw data is often not a viable option, data reduction has to be employed. To achieve this, the individual channel signals are converted, and the data is processed close to the sensor, extracting observable parameters of the signal. Recent developments often rely on low-level, analog blocks and simple digitizers as signal converters, which are tailored to the specific sensor used in the detector. This limits reusability, making a repeated design effort necessary. The design of generic readout electronics based on digital data processing could overcome this issue. In a pursuit to build such a generic detector readout, part of the necessary work is the design of a single channel signal conversion and data handling, both to be used for a wide range of detectors with different sensors. For this, MatLab and Simulink are used to study and evaluate signal and data processing chains. This includes shaping, different digitization approaches (e.g. TDC, ADC) and data processing algorithms. This contribution will describe the models used as input signals for simulations, the architecture of the simulation software, and introduce first algorithm implementations.

Summary:

Detektoren und Systeme / 20

CoRDIA detector development

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Summary:

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Abschluss

Author: Peter Goettlicher[1]

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Summary:

Sensorik / 22

FAMEIO: Femto Ampere Measurement Unit for Ethernet-IO

Author: Timo Kirschke[1]

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Zur Messung von Ionenströmen über mehrere Dekaden verwendet man im HZDR an der SuperSIMS-Anlage bisher Geräte aus den DDR-80ern: “MV40”.
FAMEIO soll diese Geräte ersetzen, unter Beibehaltung der Quasi-Analoganzeige und des Formfaktors, jedoch mit zusätzlicher Ausstattung, wie Datenspeicherung, Fernsteuerung, LAN.
Gleichzeitig ist der Messbereich nach unten zu erweitern und die obere Grenzfrequenz zu erhöhen.
Der Vortrag stellt u.a. Teillösungen und einige Problemstellen vor, die sich im Laufe der Entwicklung ergaben.

Summary:

Detektoren und Systeme / **23**

Von ”Unmöglich” zu ”Licht an” - das ”Light Shining Through The Wall”-Experiment am DESY

Author: David Reuther[1]

[1] *ALPS (ALPS _ Any Light Particle Search)*

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Summary:

Detektoren und Systeme / **25**

Future Axion Search Experiments at DESY

Author: Uwe Schneekloth[1]

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Summary:

Arbeitstreffen - Künstliche Intelligenz hardwarenahe Edge-KI / **26**

Arbeitstreffen - Künstliche Intelligenz hardwarenahe Edge-KI – Öffentliches Material

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