The FIRE Symposia Series: FPGA Innovation Research Exchange

4TU.NIRICT Community Funding 2023

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The 4th FIRE event took place at SURF in Utrecht on December 6th, 2024.

An international FIRE workshop was organized at the FPL conference, in Leiden, on September 2nd, 2025.

High-performance computing and data analytics (HPCDA) are currently driven by an increasing demand for computing and sustainability, which has largely favored GPUs due to their high performance and reasonable energy efficiency. FPGAs offer greater flexibility and energy efficiency, but have received less attention, despite their benefits. In fact, FPGAs have been proven efficient for many applications, from machine learning model inference (even at the edge) to scientific computing and data analytics. Yet, the widespread use of FPGAs is hindered by a general lack of understanding of the technology and its capabilities, combined with complex and cumbersome programming and deployment, and the (perceived) need for digital hardware knowledge. This often means that many applications use energy-hungry computing resources (like GPUs or CPUs) instead of a more sustainable approach (FPGA-based).

The overarching goal of the FIRE (FPGA Innovation Research Exchange) project was to create a community to boost the research and use of FPGA technology for HPCDA; a community that will unite researchers in HPC, electrical engineering, computational science, data science, and performance engineering, and will collect and explore applications, tools, and best-practices for using FPGAs in HPCDA. To reach this ambitious goal, the consortium collaborated closely with the HW Acceleration Network NL, and jointly organized a series of scientific meetings.

On June 21-22, 2023, SURF in Utrecht hosted the inaugural FIRE event [1]. The first day featured informative talks from the hardware acceleration community, including keynote speeches from Christian Plessl of the Paderborn Center for Parallel Computing and Lucian Petrica from AMD Xilinx. Christian provided insights on Heterogeneous Accelerated Computing, covering architectural design, software, and application perspectives.

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The second FIRE symposium [2] took place on December 6th, 2023 (SURF, Utrecht). The keynote speaker of this event was Christos-Savvas Bouganis from Imperial College London. He talked about challenges and opportunities in using FPGAs for implementing deep neural networks. Moreover, we had multiple talks from researchers at Dutch institutes and universities such as TU Delft, TU/e, VU and WUR. We also had interesting presentations from industry (Stream HPC, IMEC, Optiver and Thales).

The third FIRE symposium [3] was organized on June 27th, 202 (SURF, Utrecht). This event focused on tools and hardware platforms for accelerating AI workloads. We had two keynote speakers: 1) Koen Bertels from University of Gent who talked about quantum computing, and 2) Kees van Berkel from TU/e who talked about computing with cellular automata. In addition, we had interesting presentations from industry (Groq, Innatera, Julia Hub, Altera and AMD) as well as lightning talks from Dutch-affiliated university researchers.

The fourth symposium of the series [4] was held on December 6th, 2024 (SURF, Utrecht). One of our keynote speakers was Henk Corporaal from TU/e who discussed recent architectural innovation, in particular for deep learning applications. Our second keynote speaker was Kentaro Sano from the Riken supercomputer center in Japan. He presented challenges and lessons learned from deploying an experimental FPGA cluster as an extension to the Fugaku supercomputer. In addition to talks from Dutch-affiliated universities, such as UTwente and TU Delft, we also had presentations from industry; AMD, Samsung, Axelera AI and Snap presented their recent work on architecture and processor design.

SURF in Utrecht hosted the fifth edition of the FIRE series [5] on June 27th, 2025. As the focus of this edition was on high-throughput data movement and data abstraction, we were pleased to have Peter Hofstee from IBM. He presented the approaches and lessons learned in raising the abstraction level of hardware design. The second keynote speech was by Christiaan Baaij from QbayLogic, who presented high-level hardware design using Clash. In addition to presentations from research universities (TU Delft, TU Darmstadt and University Groningen), we also had talks from industry (NVIDIA and Voltron Data).

On September 2nd, 2025, an international FIRE workshop (FIRE-NL [6]) was organized at FPL2025, at the Corpus Congress Centre in Leiden. At this event, we had invited speakers from our community to present FPGA activities within the Netherlands. It was a half-day workshop with three sessions. In the first session, researchers from ETH Zurich, TU Delft and Vrije Universiteit presented their work on using adaptive computing platforms for non-AI applications. In the second session, we had presentations from QbayLogic and TU Delft; they talked about increasing the abstraction level of hardware design. In the third session, we highlighted Dutch research on using FPGAs in various applications in the field by researchers from TU/e, ESA and Optiver.

The 2023-2025 FIRE series of symposia created and strengthened a community to boost the research and use of FPGA technology in the Netherlands. Harnessing the full potential of advanced FPGA-based systems, however, demands more than just comprehending the inherent capabilities and limitations of FPGA technology. It necessitates a deep understanding of how these attributes align with and serve the diverse computational requirements across various domains and applications. To this end, within the FIRE project, we surveyed the present landscape of FPGA innovation research in the Netherlands, delving into the ongoing projects, advancements, and breakthroughs in the field. A survey study was published [6] and provides valuable insights beyond a mere snapshot of the present landscape; it aspires to serve as a foundational resource, possibly guiding future national-level investments in FPGA technology. This survey serves as a pivotal tool in advancing a forward-looking national FPGA strategy while strengthening the FIRE community of researchers, industry partners, and innovators. By fostering collaboration and shared knowledge, the FIRE project contributes to building a resilient FPGA ecosystem that keeps the nation at the forefront of innovation and maximizing its potential for future technological advancements.

References

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