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Safety Controllers on Standard Hardware for High-Precision Applications Using Floating-Point Arithmetic

SIListra Systems presents a global technology innovation for the development of safety solutions on non-safety standard hardware at SPS 2025 in Hall 7 at Booth 677

Summary

SIListra Systems GmbH, based in Dresden, sets a new benchmark in functional safety with the upcoming version 3.0.0 of the *SIListra Safety Transformer*: for the first time, the solution enables the direct use of floating-point arithmetic (`float`, `double`, IEEE 754) with coded processing - without complex emulation. This makes the development of highly complex yet efficient safety controllers on standard hardware a reality. Furthermore, the new version enables the creation of modular architectures, as software components can now be safeguarded independently and flexibly combined into new applications. Together with the optional *SIListra Safety Math Library* for high-performance mathematical functions, the SIListra Safety Transformer offers customers decisive competitive advantages in implementing scalable and reliable solutions - ranging from robotics to industrial automation, process control, and sensor fusion applications.

Full Release

System developers in industrial automation, robotics, and sensor technologies face rising demands for functional safety. Random hardware faults must be reliably diagnosed and corrected by the system (e.g., bit-flips occurring during computations, data storage, or transmission).

Two established methods exist to detect random errors: hardware redundancy and coded processing. In hardware redundancy, separate hardware channels compare intermediate results and outputs to detect random faults. However, such multi-channel hardware must be specifically designed for cross-checking, significantly increasing both complexity and development costs compared to standard hardware.

In contrast, coded processing allows the execution of safety applications on standard commercial off-the-shelf (COTS) hardware. Here, redundancy is implemented in software. First, automatically encoding the software ensures that the two software channels are implemented differently so that a common error will affect them differently. By comparing channel outputs, the system can detect errors. Second, coded processing introduces additional information redundancy, allowing even a single software channel to detect certain errors.

Until now, coded processing solutions have generally only supported integer arithmetic. Applications requiring floating-point arithmetic had to rely on costly software emulation. For the first time, SIListra Systems now introduces direct support for floating-point arithmetic with coded processing, eliminating the need for time- and resource-intensive emulated floating-point operations using integer arithmetic.

The new version 3.0.0 of the SIListra Safety Transformer development tool supports standard floating-point data types—`float` (32-bit) and `double` (64-bit)—along with all IEEE 754-based computations in C and C++. In addition, the optional SIListra Safety Math Library provides safe, high-performance implementations of mathematical functions such as trigonometry, with well-defined accuracy. The solution only requires IEEE 754-compliant hardware, which has long been standard across all CPU manufacturers.

Another key characteristic of complex safety applications is modularity: they often consist of individually developed software components. With SIListra Safety Transformer 3.0.0, users can independently safeguard each software component using coded processing. This allows verified components to be easily recombined into new safety applications.

For partners and customers leveraging the SIListra Systems Tools as well as related products and services, the new solution provides significant competitive advantages. In particular, it enables the development of modular, scalable, and efficient safety controllers for highly complex use cases, such as object and person recognition or trajectory planning in robotics. Such proven implementations are now directly supported by the SIListra Safety Transformer and can, for the first time, be safeguarded with coded processing.

The basis for this new product solution were developed as part of the ZIM project SafeFloat in collaboration with the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) at the University of Stuttgart between January 1, 2023, and June 30, 2025. The ZIM project was funded by the Federal Ministry for Economic Affairs and Climate Protection (BMWK) on the basis of a resolution of the German Bundestag.

Image 1: The SIListra Safety Transformer 3.0.0 supports floating point arithmetic for the first time, and is therefore ideally suited for safeguarding robotics controls or sensor solutions.

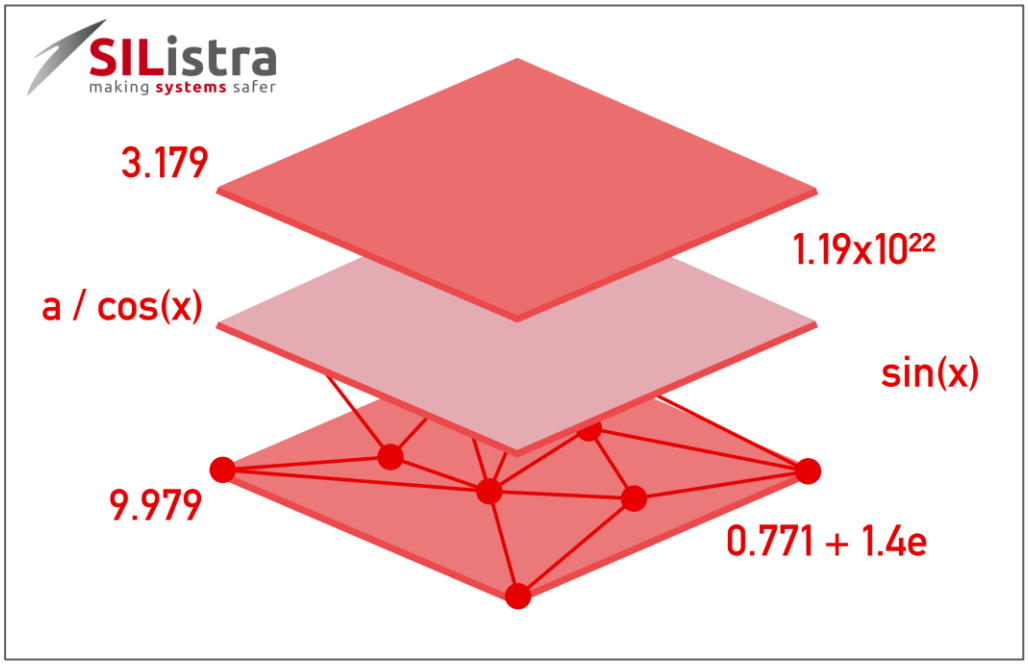

Image 2: The SIListra Safety Math Library provides high-performance and accurate support for the most important mathematical functions.

About SIListra Systems:

SIListra Systems GmbH is a highly specialized technology company spun off from TU Dresden in 2012. With the company's software-based solutions, safety-critical applications can be implemented on standard hardware. Global manufacturers in the fields of industrial automation, robotics, and sensor solutions in Germany, Austria, France, and Italy use SIListra Systems' technologies and software tools. More information about the company, its TÜV SÜD certified development tool, and engineering services is available at silistra-systems.com.

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