Karlsruher Institut für Technologie

Fakultät für Informatik
Institut für Anthropomatik und Robotik (IAR)
Lehrstuhl für Intelligente Sensor-Aktor-Systeme (ISAS)
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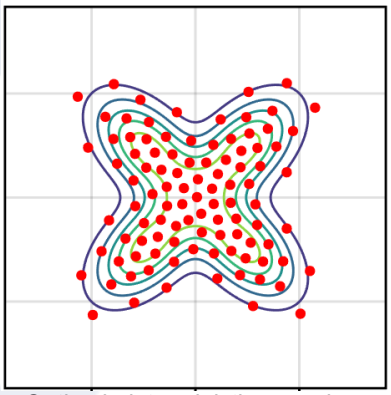
Intelligente ISAS Sensor-Aktor-Systeme

Bachelorthesis/Hiwi job

GPU-accelerated optimal deterministic sampling

Drawing samples from a probability distribution is an essential task in stochastic information processing and machine learning. An alternative to the commonly used random samples are deterministic samples that are deliberately placed to represent the underlying distribution as closely as possible with a given number of samples. In many applications they show better convergence rates than random samples.



Optimal deterministic samples of a Gaussian mixture density

At ISAS we are developing new algorithms to generate optimally placed deterministic samples for different classes of probability distributions. Many of these algorithms are suitable to parallelization and acceleration on GPGPUs, potentially increasing their viability for time critical applications.

Some examples for such algorithms are sampling and sample reduction based on Localized Cumulative Distributions or Projected Cumulative Distributions. These are already implemented in Julia as sequential/thread-parallel versions on the CPU. The tasks in this thesis/Hiwi job are:

- Implementation of GPU-accelerated version of one or more selected algorithms for optimal deterministic sampling.
- Code optimization with respect to runtime and memory consumption
- Documentation and testing of the implemented algorithms
- Comparison of the new algorithms with sequential and/or thread-parallel CPU versions

Requirements:
This topic is suited for students with a background in computer science, mathematics, electrical engineering, or other engineering majors. High motivation, reliability, and a methodical and independent approach to work are expected. Prior knowledge in GPU programming, Julia, or nonlinear optimization is advantageous.

Emphasis:

Theoretical Study	
Software Implementation	
Hardware Implementation	

We offer:
- Excellent support and advice
- High-end infrastructure
- Contacts to industry and research partners

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