

High-Quality Deterministic Gaussian Samples

Sampling from the **Gaussian** density is a ubiquitous problem. Alongside the **random** samples (iid, independent identically distributed), there are **deterministic** samples, where sample positions are chosen as homogeneously as possible, yielding superior convergence properties. At ISAS, we developed a particularly high-quality sampling procedure based on the **LCD (localized cumulative distribution)**.

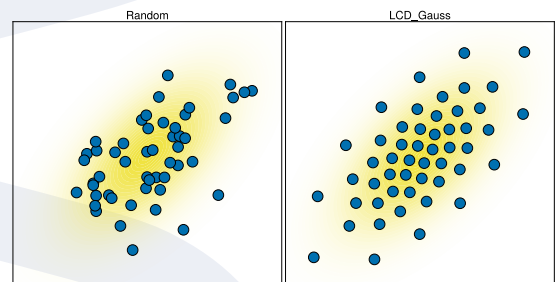
Task 1: Sample from the **standard normal** distribution, taking advantage of closed form results that are possible in this case, requiring numerical optimization only.

Task 2: Sample from arbitrary, i.e., **anisotropic Gaussian** distributions, using numerical quadrature and optimization algorithms.

Publications and reference implementations in C++ and Julia are available.

What to do

- Understand and check mathematical derivations (supported by Mathematica, where applicable)
- Implement in Julia (and C/C++ if necessary) (ideally until publishing the repository)
- Evaluate the results



Reference: Jannik Steinbring, Nonlinear State Estimation Using Optimal Gaussian Sampling with Applications to Tracking, Chapter 2.

Requirements:

Students with a background in computer science, mathematics, electrical engineering, or other engineering majors. Pre-knowledge in Mathematica and Julia are welcome. Strong self-motivation, reliability, mathematical skills, and critical mind are expected.

Emphasis:

Theoretical Study

Software Implementation

Hardware Implementation

We offer:

- excellent support and advice
- highend infrastructure
- contact to industry and research partners

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