

The background is a traditional Chinese ink wash painting. It depicts a serene landscape with misty, layered mountains in shades of green and blue. A calm river flows through the center, with a small red boat carrying a person in the lower left. Several birds, including a large white crane with black wings and a red beak, are shown in flight against a pale, hazy sky. A large, bright red sun or moon is visible in the upper left corner. The overall style is soft and atmospheric, typical of classical Chinese art.

考虑非正定相关性的改进 LHS概率潮流计算方法

汇报人：

2024-01-14



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01

引言





01

电力系统概率潮流计算的重要性

概率潮流计算是电力系统分析和设计的基础，能够为电力系统的安全稳定运行提供重要依据。

02

非正定相关性的挑战

传统的概率潮流计算方法通常假设输入变量之间相互独立或具有正定相关性，然而实际电力系统中存在大量的非正定相关性，这会对概率潮流计算结果的准确性和可靠性产生严重影响。

03

改进LHS方法的意义

针对非正定相关性的挑战，改进LHS方法能够更准确地刻画输入变量之间的相关性，提高概率潮流计算结果的精度和效率，为电力系统的安全稳定运行提供更好的支持。



国内外研究现状及发展趋势



国内外研究现状

目前，国内外学者已经提出了一些考虑非正定相关性的概率潮流计算方法，如基于Copula函数的方法、基于高斯过程的方法等。这些方法在一定程度上能够处理非正定相关性，但仍然存在计算复杂度高、适用范围有限等问题。

发展趋势

随着电力系统规模的不断扩大和复杂性的增加，未来概率潮流计算将更加注重计算效率和精度的平衡。同时，随着人工智能和机器学习等技术的不断发展，基于数据驱动的概率潮流计算方法也将成为研究热点。



本文主要工作和贡献



提出改进LHS方法

本文提出了一种考虑非正定相关性的改进LHS概率潮流计算方法，通过引入合适的变换和采样策略，能够更准确地刻画输入变量之间的相关性。

验证方法的有效性

通过多个算例的测试和比较，验证了本文所提方法的有效性和优越性，结果表明该方法能够显著提高概率潮流计算结果的精度和效率。

拓展应用场景

本文还将所提方法应用于实际电力系统中，探讨了该方法在电力系统分析和设计中的应用前景，为电力系统的安全稳定运行提供了更好的支持。



02

LHS方法基本原理及存在问题

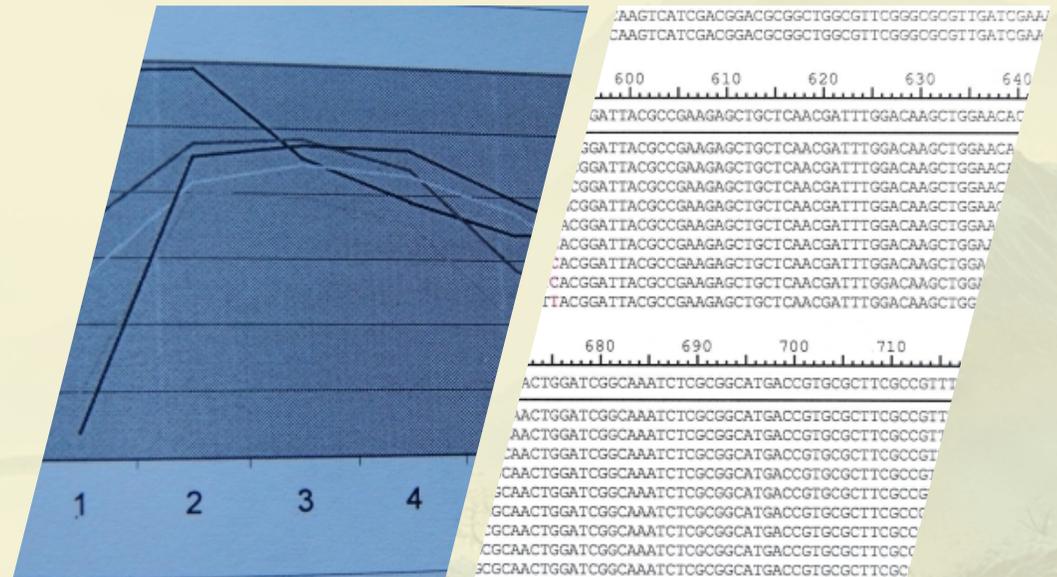




LHS方法基本原理介绍

- 拉丁超立方抽样 (Latin Hypercube Sampling , LHS) 是一种统计方法，用于生成一组均匀分布在指定范围内的样本点。它通过将每个维度划分为等概率的区间，并在每个区间内随机抽取一个样本点，从而确保样本点在每个维度上的投影都是均匀分布的。LHS方法适用于多维参数空间的抽样，具有高效、稳定和易于实现的优点。

	Feb	Mrz	Apr
97	9.727	9.922	10.403
99	11.672	11.906	12.483
104	11.459	11.688	12.255
	3.366	3.433	3.600
	2.060	2.101	2.200
	1.717	1.751	1.800
	1.416	1.444	1.500
	297	303	310
	41.713	42.648	



LHS方法存在问题分析



样本点聚集

传统的LHS方法在生成样本点时，没有考虑样本点之间的相关性，可能导致样本点在某些区域过度聚集，而在其他区域过于稀疏，从而影响抽样结果的准确性和稳定性。

非正定相关性处理

当考虑非正定相关性时，传统的LHS方法可能无法有效处理，因为非正定相关性可能导致样本点在某些维度上的投影不再均匀分布，从而影响抽样结果的可靠性。

2012年03月02日 小时均值日报表

	上一日	下一日			
站号	风速 (m/s)	风向 (°)	气温 (°C)	湿度 (%)	气压 (psi)
01	1.5	236.0	14.1	81.9	1013.0
02	1.4	237.4	14.0	82.5	1012.4
03	1.5	238.5	13.8	83.6	1012.1
04	1.5	243.3	13.8	83.7	1011.5
05	2.0	251.8	13.6	85.1	1011.4
06	2.2	261.5	13.5	86.1	1011.9
07	1.6	223.1	13.4	87.0	1012.7
08	1.4	207.3	13.8	86.3	1013.3
09	1.8	146.8	14.2	84.6	1014.3
10	2.0	154.3	14.7	82.6	1014.8
11	2.2	168.2	15.8	77.9	1014.7
12	2.6	153.5	16.4	75.5	1014.4
13	3.4	145.8	16.5	74.1	1013.6
14	2.2	173.9	17.3	70.8	1013.0
15	2.6	167.9	16.7	71.6	1012.7
16	2.7	224.4	16.0	74.8	1012.8
17	2.1#	160.3#	15.3#	77.9#	1013.3#
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非正定相关性对LHS方法影响



抽样效率降低

非正定相关性可能导致样本点在某些维度上的投影重叠，从而增加了抽样所需的样本点数量，降低了抽样效率。

结果偏差

非正定相关性可能导致抽样结果产生偏差，因为样本点在某些维度上的不均匀分布可能使得某些区域的概率被高估或低估。

稳定性下降

非正定相关性可能导致LHS方法的稳定性下降，因为样本点的不均匀分布可能使得抽样结果对初始样本点的选择更加敏感，从而增加了结果的不确定性。



03

改进LHS概率潮流计算方法提出与实现





拉丁超立方抽样 (LHS) 改进

- 针对传统LHS方法在处理高维、非线性问题时可能出现的样本聚集和重复问题，提出改进策略，如引入混沌序列、优化抽样点分布等，以提高抽样效率和精度。

考虑非正定相关性

- 针对实际电力系统中存在的非正定相关性问题，提出相应的处理策略，如引入Copula函数、构建混合分布模型等，以更准确地描述输入变量间的相关关系。



非正定相关性处理技巧探讨



Copula函数应用

利用Copula函数能够描述任意类型相关性的优点，构建符合实际电力系统输入变量相关性的联合分布模型。

混合分布模型构建

针对具有复杂相关性的输入变量，构建混合分布模型，通过调整模型参数实现对相关性的灵活刻画。



相关性检验与评估

采用合适的相关性检验方法，如Kendall秩相关系数、Spearman秩相关系数等，对构建的联合分布模型进行相关性评估，确保其准确性和有效性。

以上内容仅为本文档的试下载部分，为可阅读页数的一半内容。如要下载或阅读全文，请访问：
<https://d.book118.com/295022104120011222>