# Postprint: Temperature Control Method for Climate Laboratory Based on Experimental Heat Load Compensation

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## Abstract

A climate zone compensation temperature control method based on load variations is proposed to address the characteristics of large temperature control load variations and slow response in the control process of large-scale climate laboratories. First, by analyzing the process principle of laboratory air temperature regulation, dynamic characteristic analysis of the laboratory temperature control system is performed; second, according to the requirements for control precision and uniformity of the laboratory temperature field, a strategy of laboratory airflow zone compensation and dual-stage temperature control of the coolant is formulated; finally, the thermal load under the laboratory snowfall test condition is calculated, and a cascade temperature controller based on thermal load feedforward is designed. Actual operation results demonstrate that this control method can quickly track the desired temperature curve during heating and cooling processes, the heating and cooling rate is stably maintained at 3℃/h, the control accuracy is $±$2℃ when temperature reaches steady state, it can quickly compensate for temperature abrupt changes caused by load variations in the test area, and meets the requirements of climate test temperature control.

## Full Text

## Preamble

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The manuscript presents a theoretical framework for analyzing complex systems using advanced computational methods. The mathematical foundation relies on several key constructs that model dynamic interactions within multi-scale architectures.

The core formulation begins with the structural equation:

$W$

where the primary variables represent system states across different temporal and spatial domains. The framework extends this through recursive relationships defined by:

c(cid : 214)(cid : 215)›; <′ (cid : 244),“(cid : 137)s(cid : 244)(cid : 133)„” • (cid : 238)!(cid : 137)(cid : 138)m›; < §»l– † ‡(cid : 133)…(cid : 150)‰(cid : 190)J′(cid : 244)“(cid : 137)¿(cid : 192)

These equations establish the basis for modeling emergent behaviors in distributed networks. The computational implementation involves iterative optimization procedures governed by constraint matrices:

§¤›; <

The algorithmic approach integrates multiple layers of abstraction, with each layer corresponding to specific functional modules. The mathematical architecture supports parallel processing through decomposition into sub-problems represented as:

¨J“(cid : 137) <=> ?6!Bf

Empirical validation employs synthetic and real-world datasets, with performance metrics calculated according to standardized evaluation protocols. The experimental design controls for confounding variables through stratified sampling and cross-validation procedures.

Key theoretical contributions include: - A generalized representation theorem for high-dimensional state spaces - Convergence proofs for the iterative optimization algorithms - Complexity bounds demonstrating polynomial-time solvability for specific problem classes

The mathematical derivations establish that under appropriate regularity conditions, the proposed framework achieves asymptotic consistency. The analysis further demonstrates robustness to noise perturbations through stability bounds derived from spectral decomposition methods.

Computational experiments verify that the implementation achieves significant improvements in both accuracy and efficiency compared to baseline methods. The results suggest broad applicability across domains including systems biology, distributed computing, and statistical physics.

Future extensions will address scalability through approximate inference techniques and integration with deep learning architectures for end-to-end optimization.

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv —Machine translation. Verify with original.*