模拟赛题说明
Analog Competition Description

竞赛课题：基于AI智能体的FVF LDO自动优化设计
Competition Topic: AI Agent-Based Automatic Optimization Design of FVF LDO

一、竞赛任务
I. Competition Task

本赛题要求参赛队伍设计一款AI智能体，实现一款基于FVF（Flipped Voltage Follower）结构的LDO自动化优化设计。该LDO的具体电路拓扑结构和基础参数指标详见论文《A Fully Integrated FVF-Based Low-Dropout Regulator With Wide Load Capacitance and Current Ranges》，IEEE Trans. Power Electron. 34(12), 11880–11888 (2019)。工艺选择为TSMC 65nm GP。

参赛队伍需要自行选择大语言模型（如Claude，GPT-4，Qwen等）并搭建智能体框架。通过智能体自动化调用电路仿真工具完成电路元件参数的调整与优化工作。

This competition requires participating teams to design an AI agent that realizes the automated optimization design of an LDO based on the FVF (Flipped Voltage Follower) structure. The specific circuit topology and basic parameter specifications of this LDO are detailed in the paper: "A Fully Integrated FVF-Based Low-Dropout Regulator With Wide Load Capacitance and Current Ranges," IEEE Trans. Power Electron. 34(12), 11880--11888 (2019). The chosen process is TSMC 65nm GP.

Participating teams need to select a large language model (e.g., Claude, GPT-4, Qwen, etc.) and build an agent framework independently. The optimization of circuit component parameters must be completed by the agent automatically invoking circuit simulation tools.

二、设计规范
II. Design Specifications

2.1 输入输出要求
2.1 Input/Output Requirements

AI智能体需接收一组LDO的设计目标参数作为输入，包括输入电压、输出电压、Dropout电压、最大负载电流、静态电流、3 sigma输出电压精度、负载调整率、输出电容、负载瞬态性能（负载阶跃幅度、速度、过冲/跌落值）、电源抑制比等基本参数（与论文中的指标有区别）。

完整运行智能体的推理和脚本调用EDA工具进行仿真流程，输出为电路/电路网表、仿真指标结果。

The AI agent shall receive a set of design target parameters for the LDO as input, including input voltage, output voltage, dropout voltage, maximum load current, quiescent current, 3-sigma output voltage accuracy, load regulation, output capacitance, load transient performance (load step magnitude, slew rate, overshoot/undershoot values), power supply rejection ratio, etc. (These parameters differ from the metrics in the paper).

Upon completing the inference and the process of invoking EDA tools for simulation, the agent shall output the circuit/circuit netlist and the simulated performance metrics results.

2.2 验证要求
2.2 Verification Requirements

参赛队伍需要提供完整的功能仿真环境，证明设计的正确性。验证时至少需要在5组测试目标参数上进行测试。

Participating teams must provide a complete functional simulation environment to demonstrate the correctness of their design. Verification must be tested on at least five sets of target parameters.

三、评分体系
III. Scoring System

竞赛采用基础分加权重分的评分方式。完成基本功能并通过验证的队伍可获得基础分60分，剩余40分根据精度和性能表现进行加权评分。

The competition adopts a scoring method combining a base score and weighted scores. Teams that complete the basic functionality and pass verification will receive a base score of 60 points. The remaining 40 points will be awarded based on a weighted evaluation of accuracy and performance.

3.1 基础分（60分）
3.1 Base Score (60 points)

设计能够完整运行滤波器优化设计的推理和自动化仿真流程，并在至少5组测试目标参数上得到合理的S参数输出，即可获得60分基础分。这里的"合理输出"是指输出格式正确，数值在预期范围内，不要求达到特定的准确率。

设计能够完整运行LDO优化设计的推理和自动化仿真闭环流程，并在至少5组测试目标参数上成功生成电路网表并完成仿真，且电路DC工作点正常、输出电压稳定（环路稳定）、带载能力正常，即可获得60分基础分。不要求规格静态功耗、瞬态性能、PSR等性能。

A design that can successfully run the complete inference and automated simulation workflow for the LDO optimization, and successfully generate circuit netlists and complete simulations for at least five sets of test target parameters, with correct circuit DC operating points, stable output voltage (loop stability), and normal load regulation capability, will receive the 60-point base score. Specific requirements for static power consumption, transient performance, PSR, etc., are not mandatory for the base score.

3.2 性能评分（40分）
3.2 Performance Score (40 points)

剩余40分按照以下权重分配：精度占50%（20分），性能50%（20分）。其中精度主要指LDO设计指标达标率，性能指LDO的推理仿真验证迭代次数。

The remaining 40 points are allocated according to the following weights: Accuracy accounts for 50% (20 points), Performance accounts for 50% (20 points). Accuracy primarily refers to the LDO design's compliance rate with target specifications, while Performance refers to the number of inference/simulation iterations required for the LDO design.

精度评分（20分）采用归一化方式计算。所有通过基础验证的队伍中，在5组测试目标参数上测试LDO的性能指标。主要性能指标：静态电流（TT and FF corner）、3-sigma精度，负载调整率、PSR@100KHz，PSR@1MHz，瞬态跌落，瞬态过冲，负载瞬态恢复时间、面积预估等。5组测试数据中，LDO指标性能最优项的累计数目最多的队伍得20分，其他队伍按比例折算。计算公式为：精度得分 = (本队准确率 / 最高准确率) × 20分。

Accuracy Score (20 points): Calculated using a normalization method. Among all teams that pass the basic verification, the LDO's performance metrics are tested on five sets of target parameters. Main performance indicators: Quiescent current (TT and FF corners), 3-sigma accuracy, load regulation, PSR@100kHz, PSR@1MHz, transient undershoot, transient overshoot, load transient recovery time, area estimation, etc. Across the five test cases, the team with the highest cumulative count of best-performing LDO metrics will receive 20 points. Other teams' scores will be scaled proportionally. Calculation formula: Accuracy Score = (Team's Accuracy / Highest Accuracy) × 20 points.

性能评分（20分）主要考察智能体推理的经济性和准确性。智能体达到目标所需的迭代次数越少或耗时越短，说明智能体的推理与初值估算越准确。采用归一化方式，性能最优的队伍得20分，其他队伍按比例折算。

Performance Score (20 points): Primarily examines the economy and accuracy of the agent's inference. The fewer iterations or shorter the time required for the agent to achieve the target, the more accurate the agent's inference and initial value estimation are considered to be. Normalization is used, with the best-performing team receiving 20 points, and other teams' scores scaled proportionally.

创新加分（最高10分）
Innovation Bonus Points (Up to 10 points)

在智能体框架设计优化技术等方面有突出表现的队伍可以获得额外加分，最高10分。智能体框架的自动化程度和通用性可获得最高5分加分，算法优化技术可获得最高5分加分。

Teams demonstrating outstanding contributions in areas such as agent framework design or optimization techniques may receive additional bonus points, up to a maximum of 10 points. The automation level and versatility of the agent framework can earn up to 5 bonus points, and algorithmic optimization techniques can earn up to 5 bonus points.

四、提交材料
IV. Submission Materials

4.1 技术报告
4.1 Technical Report

参赛队伍需要提交一份的技术报告（PDF格式），内容包括智能体框架的设计思路、量化策略与精度分析、优化方法、用户与智能体框架的交互日志和人工介入情况等。报告应清晰说明设计思路和关键技术选择。

Participating teams must submit a technical report (PDF format), including the design concept of the agent framework, quantification strategy and accuracy analysis, optimization methods, interaction logs between the user and the agent framework, and any manual intervention involved. The report should clearly explain the design ideas and key technical choices.

4.2 源代码与脚本
4.2 Source Code and Scripts

需要提交完整的Python设计代码，以及智能体相关的脚本和配置文件。同时需要提供EDA仿真测试平台的脚本代码。所有代码应有适当的注释，便于评审。

Complete Python design code, along with agent-related scripts and configuration files, must be submitted. EDA simulation testbench script codes must also be provided. All code should have appropriate comments to facilitate review.

4.3 验证报告
4.3 Verification Report

验证报告需要包含至少五个端到端的推理和自动化仿真样例、综合分析报告。

The verification report needs to include at least five end-to-end inference and automated simulation examples, along with a comprehensive analysis report.