

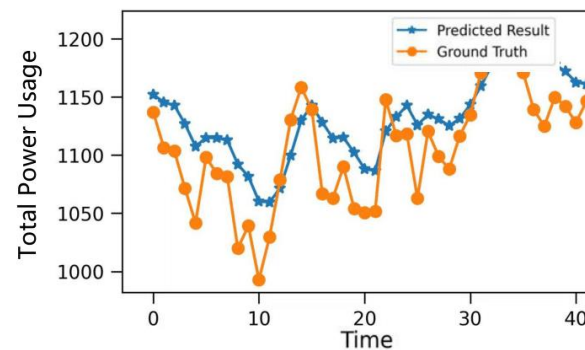
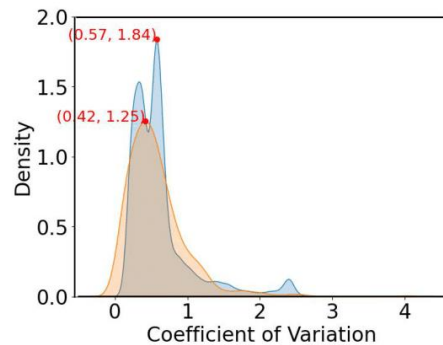
FLAPS: Fluctuation-Aware Power Auction Strategy for Reducing the Power Overload Probability

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Problems & Ideas

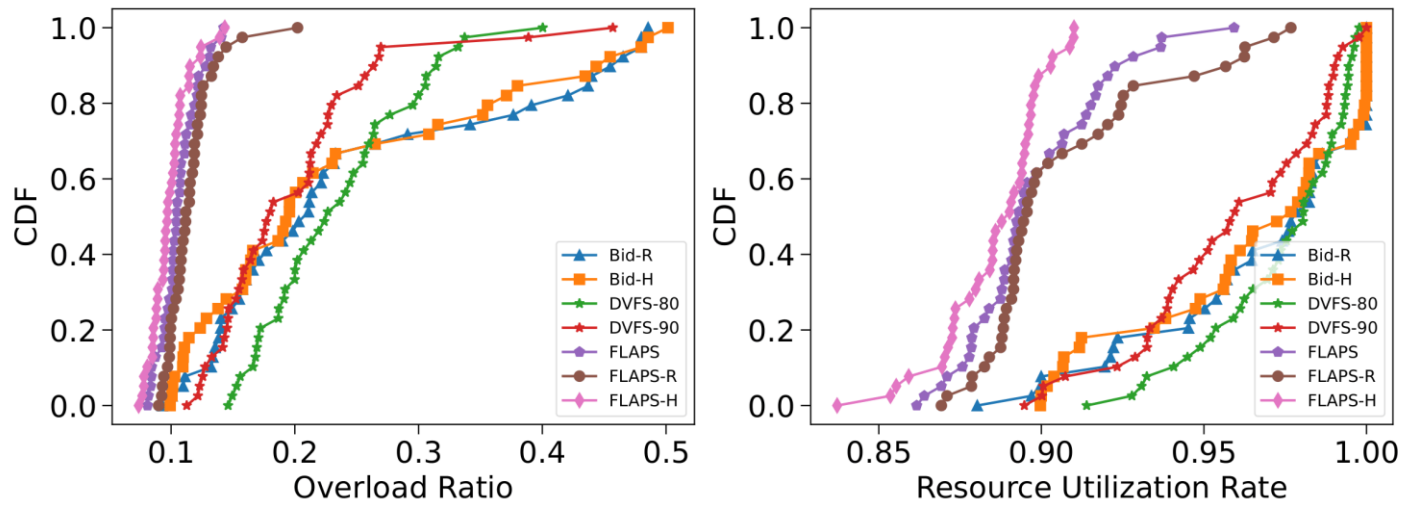
- Problems of Traditional Power Management Strategy:
 - Even with capacity oversubscription, the problem of power under-utilization persists. Additionally, it inevitably leads to power overload.
 - Market-based auctions and DVFS-based schemes both aim to leverage idle resources to further support power oversubscription. However, by ignoring workload fluctuations, they risk increasing overload issues.
- Ideas: FLAPS identifies previously overlooked job power usage fluctuations and variances. And if power predictions are more accurate and effective, they can better support proactive power management.



Motivation for FLAPS. Left shows the probability distribution of job power usage CV in Google Trace and Alibaba Trace, both data centers show CV peaks exceeding 0.3, indicating high variability in power usage. Right compares vanilla LSTM prediction results with actual resource usage.

Main Contributions

- Contributions:
 - A fluctuation-aware power auction strategy to reduce the power overload probability while maximizing the power utilization;
 - FLAPS builds an enhanced LSTM model for power-fluctuating jobs. The power usage prediction module improves the vanilla LSTM model by incorporating a feature selection layer.
 - FLAPS adds the variance of job power usage to the auction strategy to support jobs with smaller variances to use unused power capacity.



Left: FLAPS can reduce the power overload by 10.89% and 9.12% on average compared to Bid-H and DVFS-90, respectively. Right: With an overload ratio of no more than 15%, the discrepancy in resource utilization between FLAPS and Bid-H, as well as DVFS-90, is 2.4% and 2.8%, respectively.