Revisiting Deep AC - OPF

Oluwatomisin I. Dada
Neil D. Lawrence

UNIVERSITY OF CAMBRIDGE

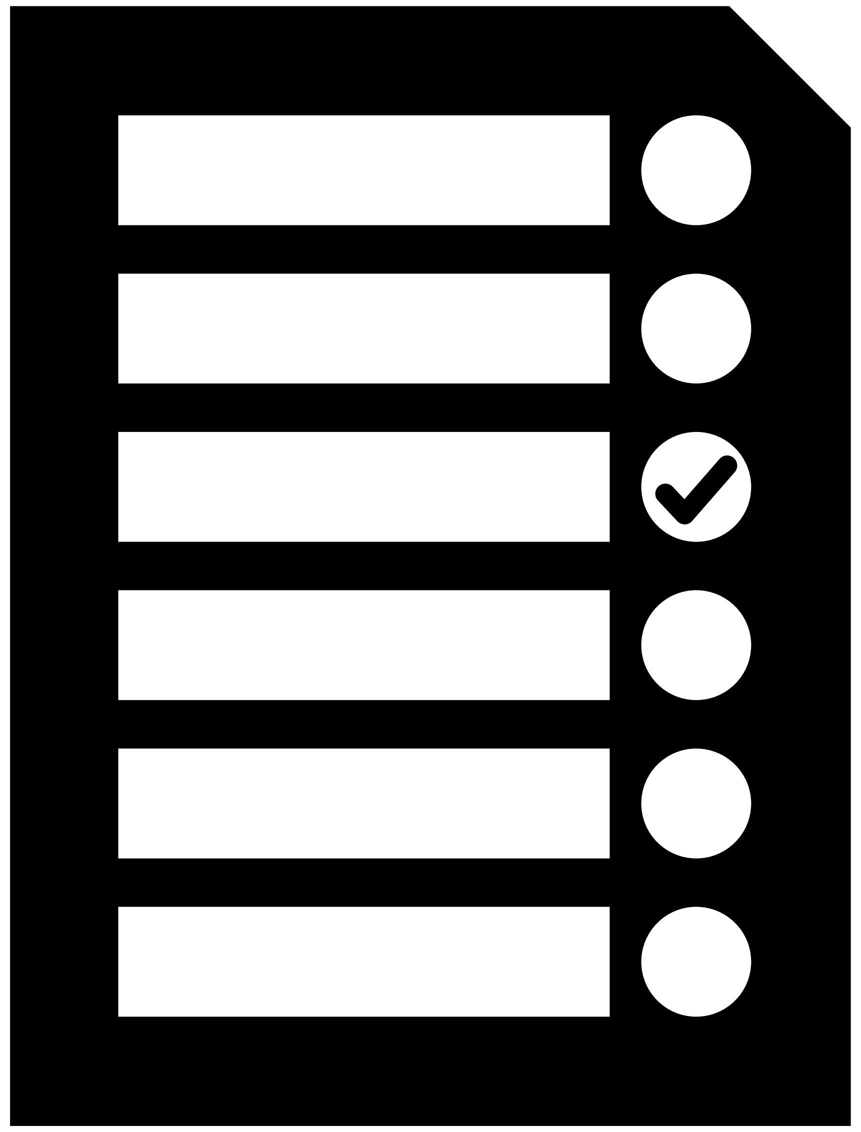
Motivation

- AC-OPF is a non-convex, non-linear, constrained optimisation problem that minimises the cost of generation
- Conventional solvers can be prohibitively slow
- ML can accelerate finding a solution

Oluwatomisin I. Dada
oid20@cam.ac.uk

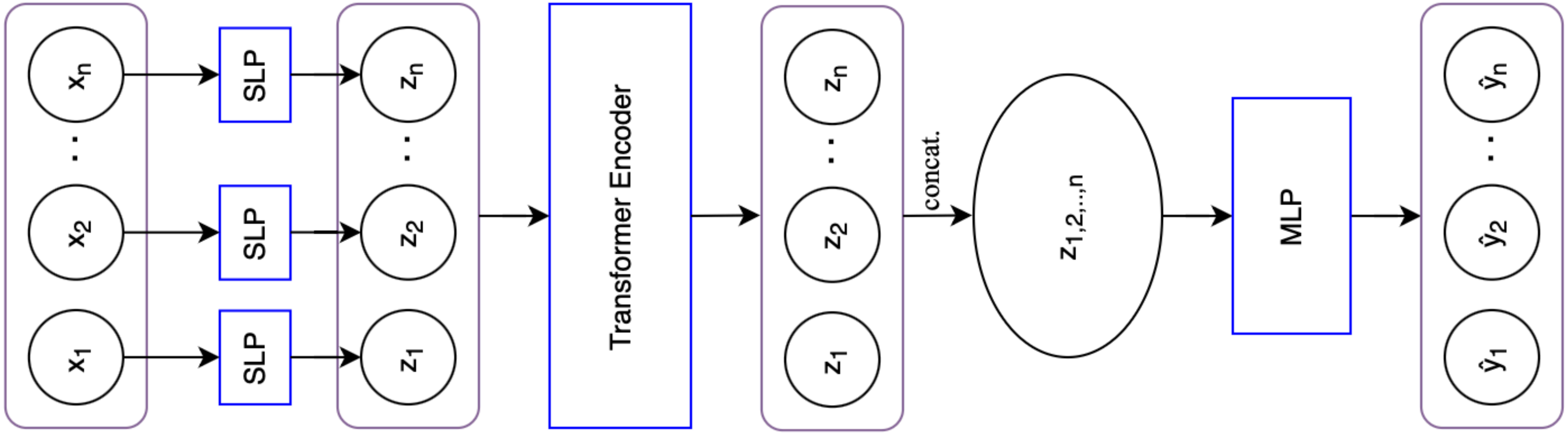
What do we want from an ML AC-OPF solver?

- Speed
- Accuracy
- Feasibility
- Scalable
- Topologically Adaptable



Oluwatomisin I. Dada
oid20@cam.ac.uk

OPFormer - V



Oluwatomisin I. Dada
oid20@cam.ac.uk

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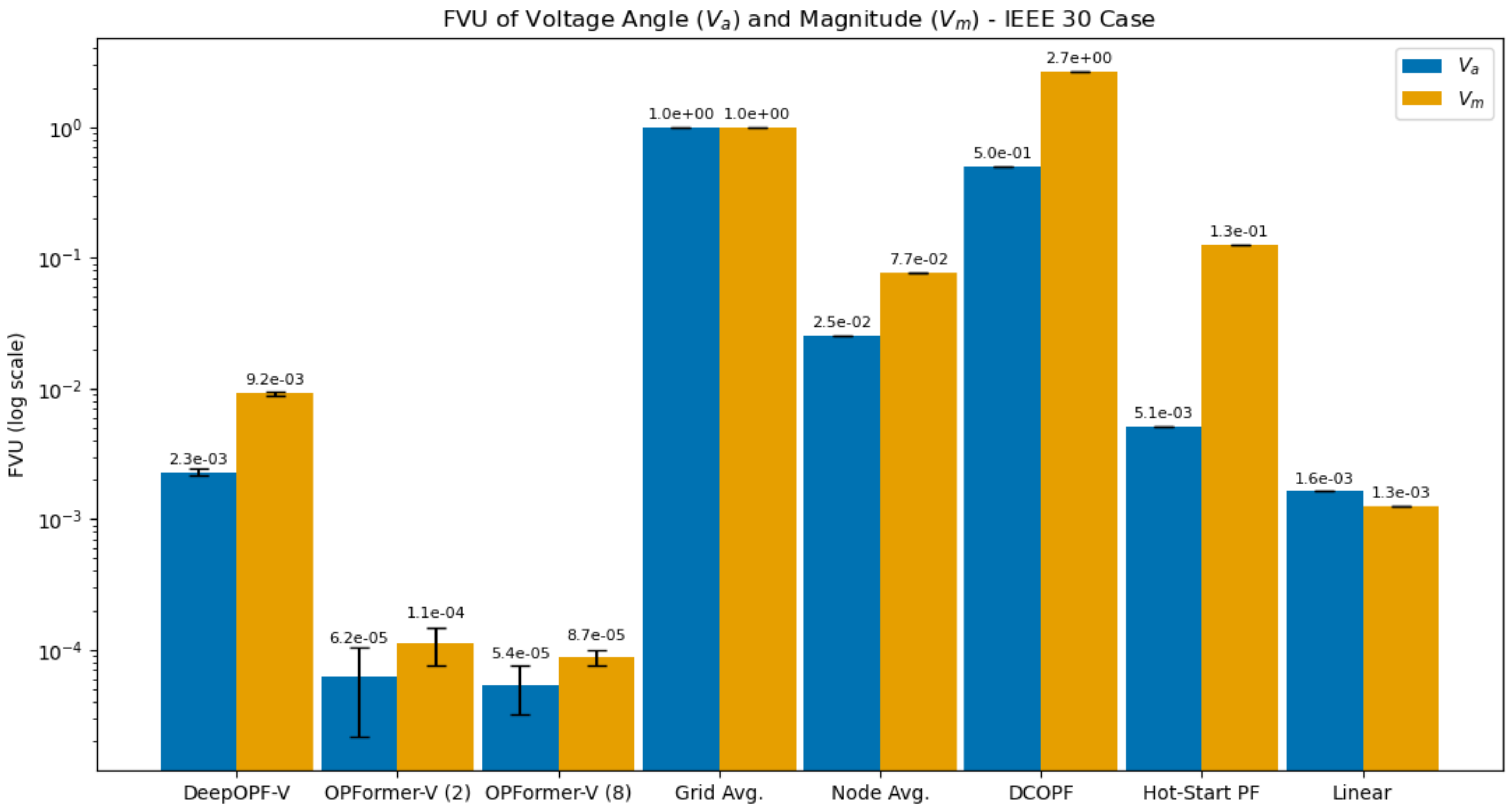
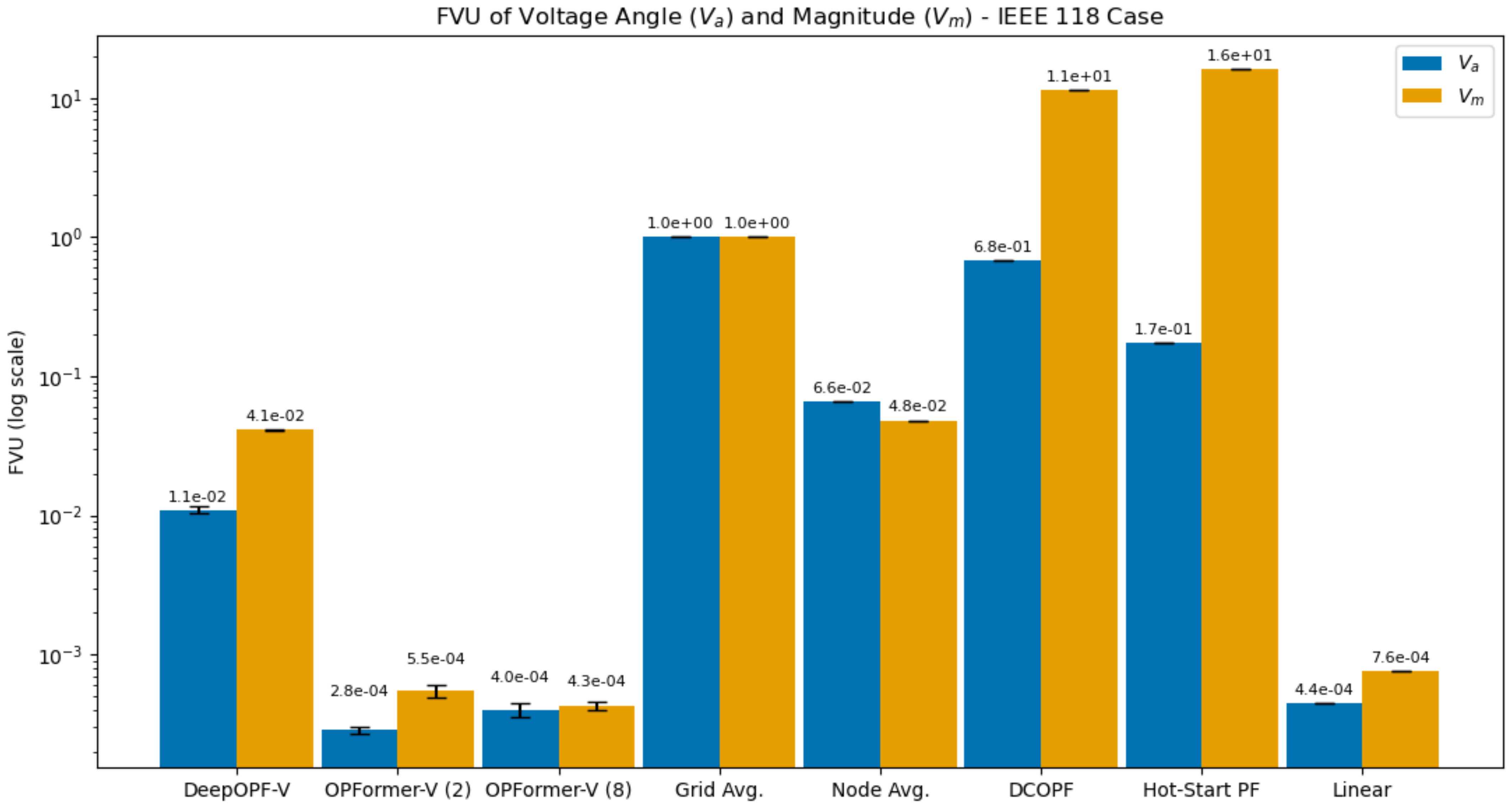
Regression Metrics





Oluwatomisin I. Dada
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Power Metrics

IEEE case 30	DeepOPF-V	OPFormer-V
Relative Opt. Diff. (%)	-0.025 ±0.082	**0.087** ±0.095
Abs. Relative Opt. Diff. (%)	2.427 ±0.023	**0.150** ±0.050
Pg Violation Rate (%)	10.984 ±0.255	**10.488** ±0.639
Qg Violation Rate (%)	**14.932** ±0.418	16.629 ±1.392
Abs. Relative Tot. Pd err. (%)	1.876 ±0.019	**0.116** ±0.038
Abs. Relative Tot. Qd err. (%)	2.151 ±0.029	**0.144** ±0.014
Avg. Abs. Relative Nonzero Pd err. (%)	22.270 ±0.138	**2.251** ±0.208
Avg. Abs. Relative Nonzero Qd err. (%)	23.627 ±0.052	**6.657** ±0.657

IEEE case 118	DeepOPF-V	OPFormer-V
Relative Opt. Diff. (%)	-0.618 ±0.012	**-0.153** ±0.053
Abs. Relative Opt. Diff. (%)	1.713 ±0.018	**0.323** ±0.045
Pg Violation Rate (%)	21.799 ±0.044	**16.468** ±0.306
Qg Violation Rate (%)	12.605 ±0.114	**11.771** ±0.742
Abs. Relative Tot. Pd err. (%)	1.242 ±0.012	**0.245** ±0.035
Abs. Relative Tot. Qd err. (%)	1.472 ±0.006	**0.241** ±0.011
Avg. Abs. Relative Nonzero Pd err. (%)	16.242 ±0.140	**4.053** ±0.182
Avg. Abs. Relative Nonzero Qd err. (%)	17.648 ±0.252	**4.934** ±0.112

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Final Thoughts

1. Transformer-based models are promising for AC-OPF
2. Simple baselines can rival complex ML models
3. ML for AC-OPF is promising but must be critically evaluated

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