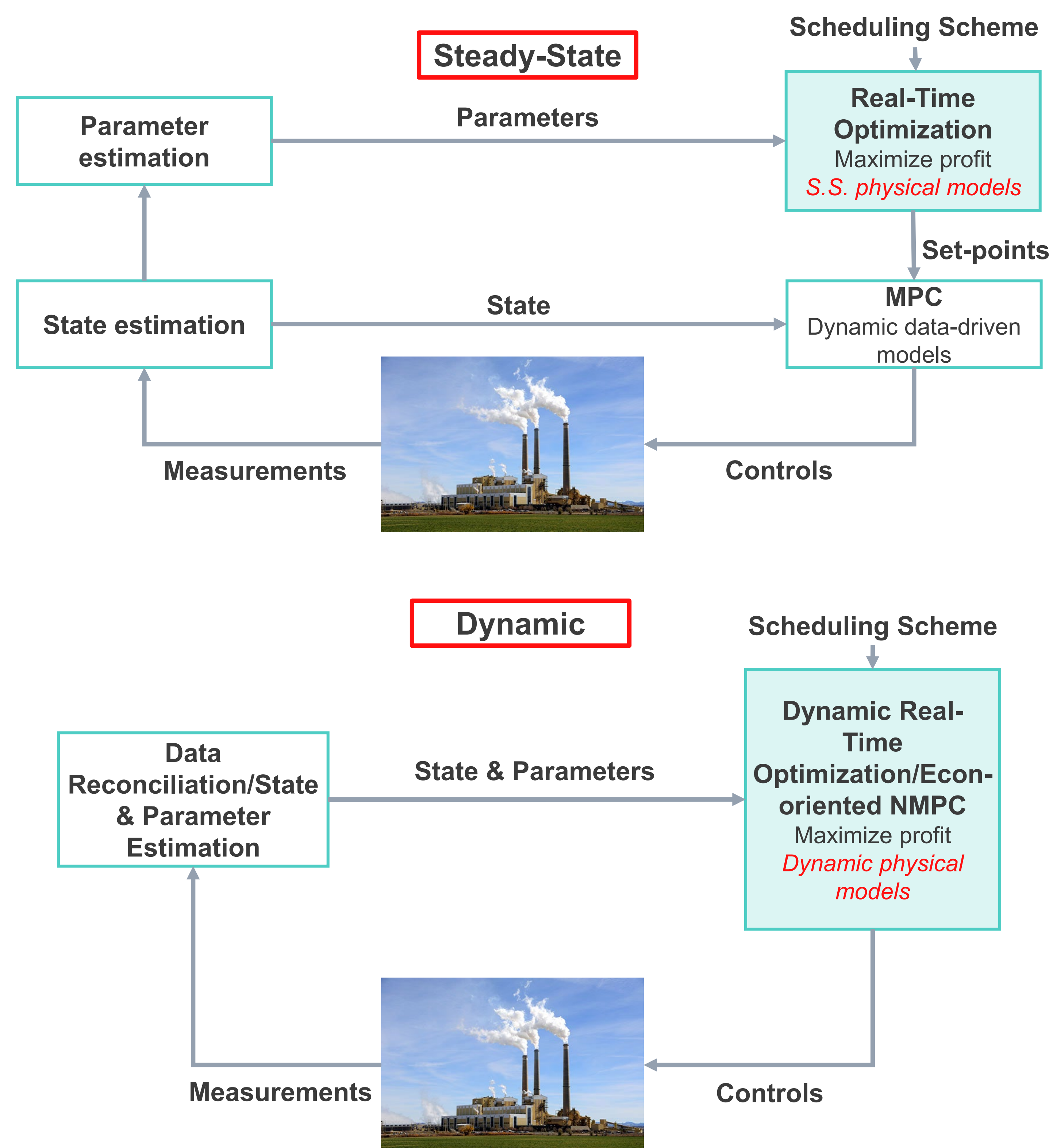


Models in Real Time Optimization



Physical models are complex and difficult to optimize-over, can we build simple surrogates to with requisite accuracy and quickness for RTO?

Linear Model Building

$$y = \sum_k \beta_k x_k + \epsilon$$

Response
 $y \in \mathbb{R}^{n \times 1}$

Regressors
 $x_k \in \mathbb{R}^{n \times 1}$
 $k \in K$
 $|K| = p$

Model-building goals:

- Simplicity
- Accuracy
- Speed

Best Subset Selection

$$OBJ(\beta, z) = \min_{\beta, z} \sum_{i=1}^n (y_i - \sum_{j=1}^p \beta_j x_{ij})^2 + \lambda \|\beta\|_0$$

- Seeks to find 'best subset' of regressors
- Computationally intensive (NP-hard)
- Recent progress in solving MIQP have allowed some problems to be solved exactly (e.g. ALAMO)
- Heuristic methods still dominant

$$-Mz_j \leq \beta_j \leq Mz_j$$

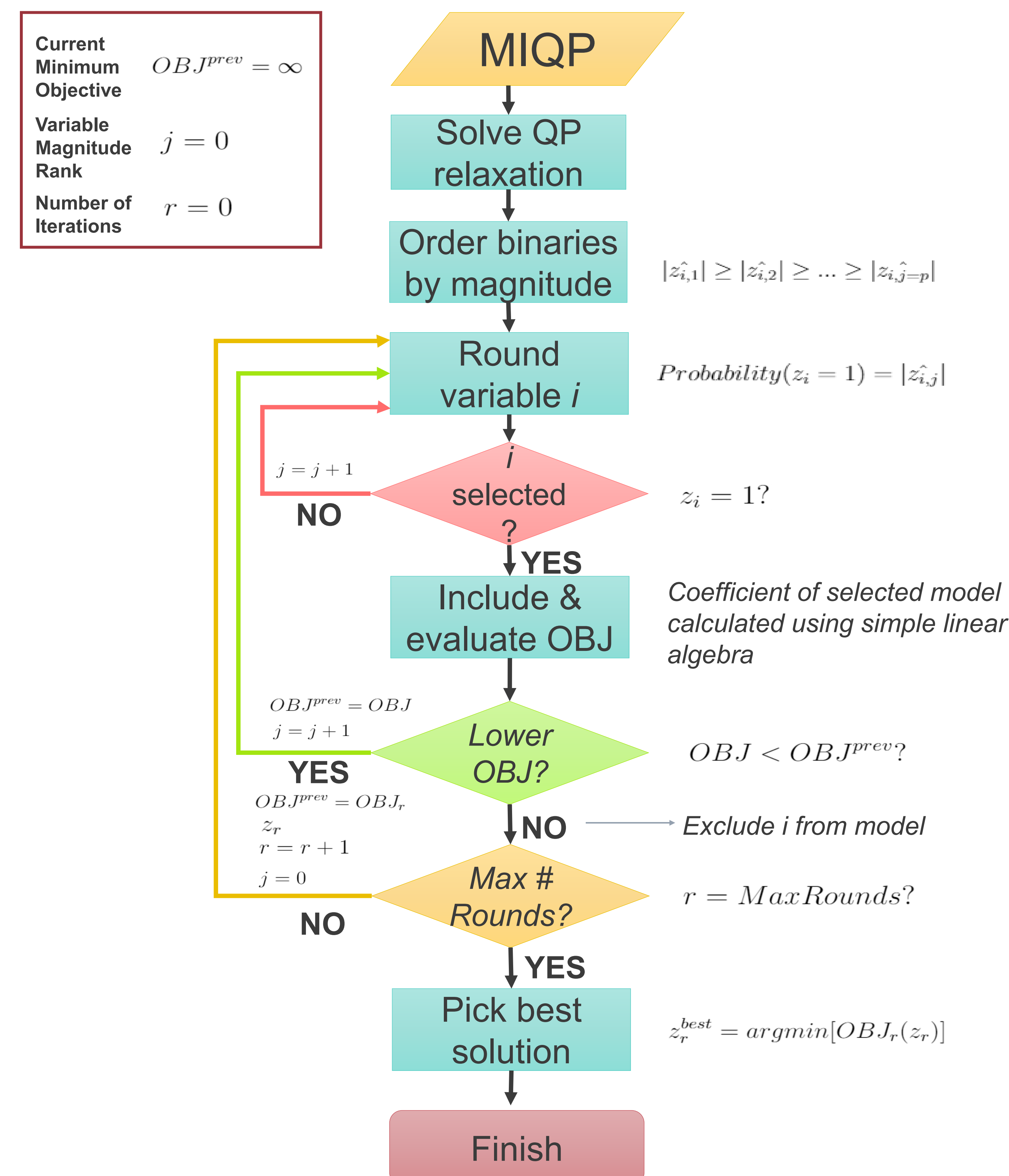
$$z_j \in \{0, 1\}^p \quad \forall j \in P$$

$$y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 \rightarrow y = \beta_1 x_1 + \beta_3 x_3 + \beta_6 x_6$$



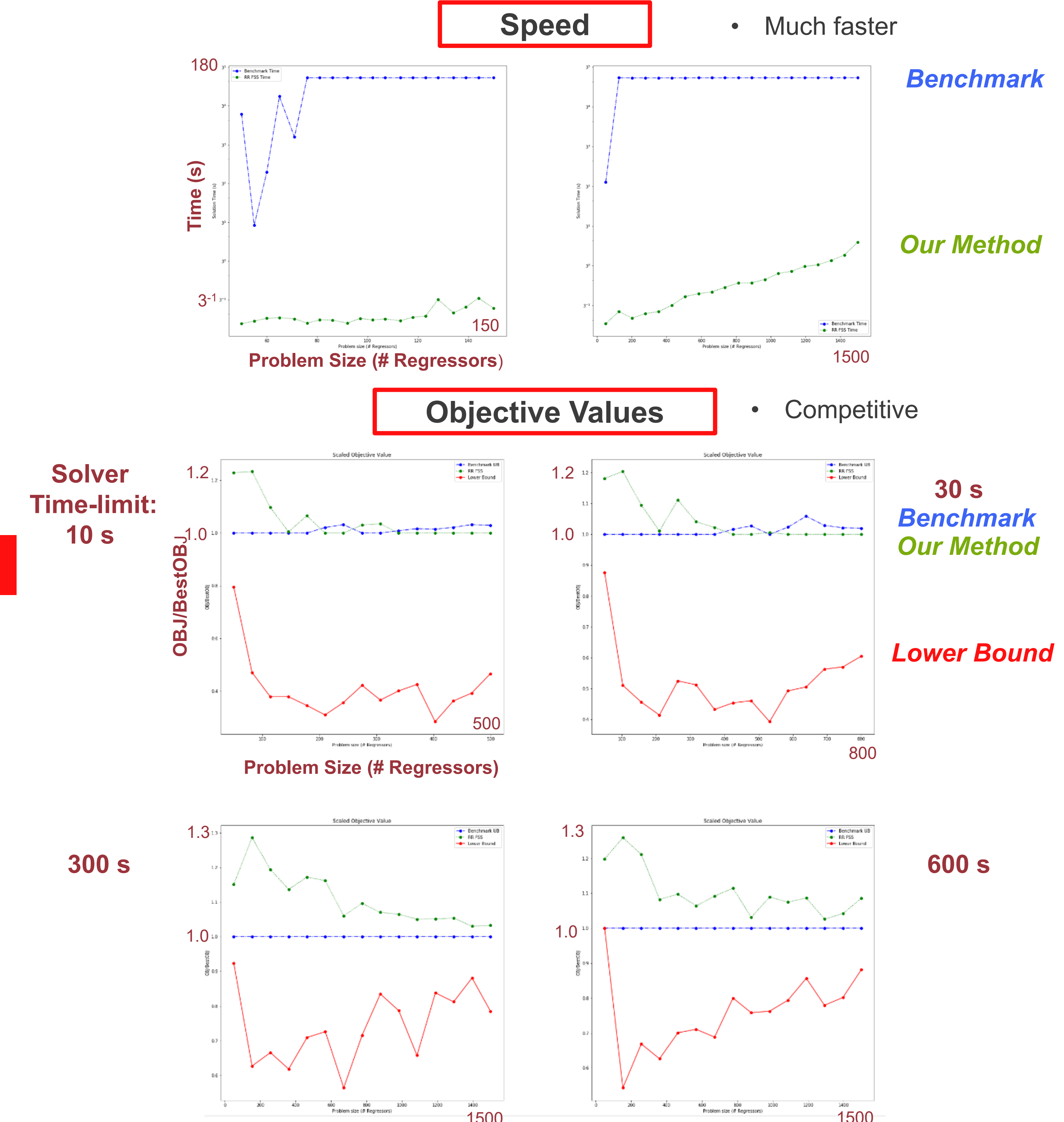
a black-box modeling tool

Randomized Rounding (RR FSS)



Experimental Questions

How does RR FSS compare with solving the MIQP 'exactly'?



Do MIQP formulation hyper-parameters affect the results?

	0.05	$\hat{\lambda}$	0.1	0.15
Heuristic OBJ / Benchmark OBJ: $p = 500, s = 10, SNR = 0.25$	3	1.17	1.11	1.05
\bar{M}	3.5	1.25	1.10	1.04
\bar{M}	4	1.2	1.01	1.05

	0.05	$\hat{\lambda}$	0.1	0.15
Heuristic OBJ / Benchmark OBJ: $p = 1500, s = 10, SNR = 0.25$	3	1.00	0.83	0.88
\bar{M}	3.5	0.99	0.81	0.90
\bar{M}	4	1.19	0.91	0.91

Conclusions and Beyond

Conclusions:

- Randomized rounding for best subset selection is a polynomial-time algorithm for constructing good-quality regression models quickly and robustly

Upcoming work:

- Test our approach in a simulated RTO-framework

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