Supplemental Material for "Effective matrix adaptation strategy for noisy derivative-free optimization". Mathematical Programming Computation (2024)

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Supplementary information for the paper [1] is discussed here, available at

`https://github.com/GS1400/MADFO`.

Section 1 provides testing for features of the `MADFO` solver, and then Section 2 classifies recommendations by the kind and level of noise and the target accuracy.

1 Testing for features of `MADFO`

We compare, on the $157 \times 2 \times 2 \times 8 = 5024$ noisy problems with the target accuracy $\varepsilon = 10^{-4}$, the default version of `MADFO` with the four versions obtained by disabling the following features:

- `goodStepSize`, finding good mutation and recombination step sizes.
- `recomSubDir`, computing recm subspace directions.
- `randomNMLS`, performing randomized non-monotone line search method.
- `triSubPoint`, computing random triangle subspace points.

Table 1 compares the default version of `MADFO` and the versions where one of these four features is dropped. For how noisy problems are generated, see [1, Section 3].

Table 1: Cumulative number of solved problems (# solved) out of 5024 noisy problems for the noise levels $\omega = 10^k$ with $k = -5, -4, \ldots, 2$ and the target accuracy $\varepsilon = 10^{-4}$.

solver	version	# solved
`MADFO`	default	**3316**
`MADFO2`	no `recomSubDir`	3285
`MADFO1`	no `goodStepSize`	3277
`MADFO4`	no `triSubPoint`	2654
`MADFO3`	no `randomNMLS`	2615

We see that turning off each feature of `MADFO` reduces the number of solved problems, but turning off the randomized non-monotone line search and random triangle subspace points reduces the number of solved much more than turning off the two other features.

Box plots, data profiles, and performance profiles in Figure 1 show that `MADFO` and `MADFO2` are more robust and efficient than the other versions. Moreover, the noise profiles show that `MADFO` and `MADFO2` are more robust and efficient than the other versions with the respect to the noise levels.

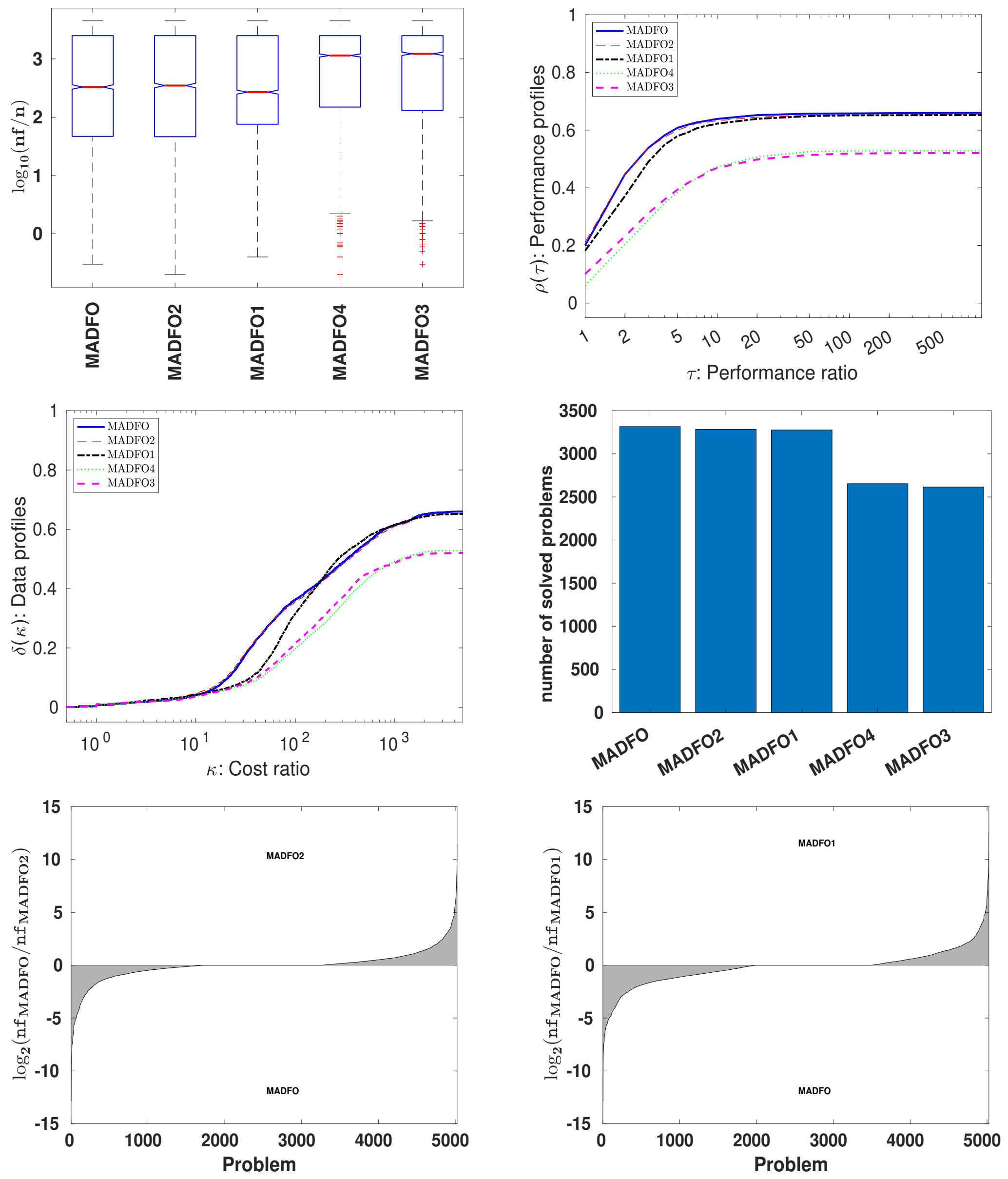

Figure 1: Data and performance profiles (first row), box plots and bar graphs (second row), and Morales profiles (third row) for noisy problems with all types of f and small dimensions $1 < n \leq 20$, generated by the absolute/relative uniform and Gaussian noises, the target accuracy $\varepsilon = 10^{-4}$, and the noise levels $\omega = 10^k$ for $k = -5, -4, \ldots, 2$. Problems solved by no solver are ignored. `MADFO` and its four versions used the budgets `secmax` $= 360$ and `nfmax` $= 2000n + 5000$.

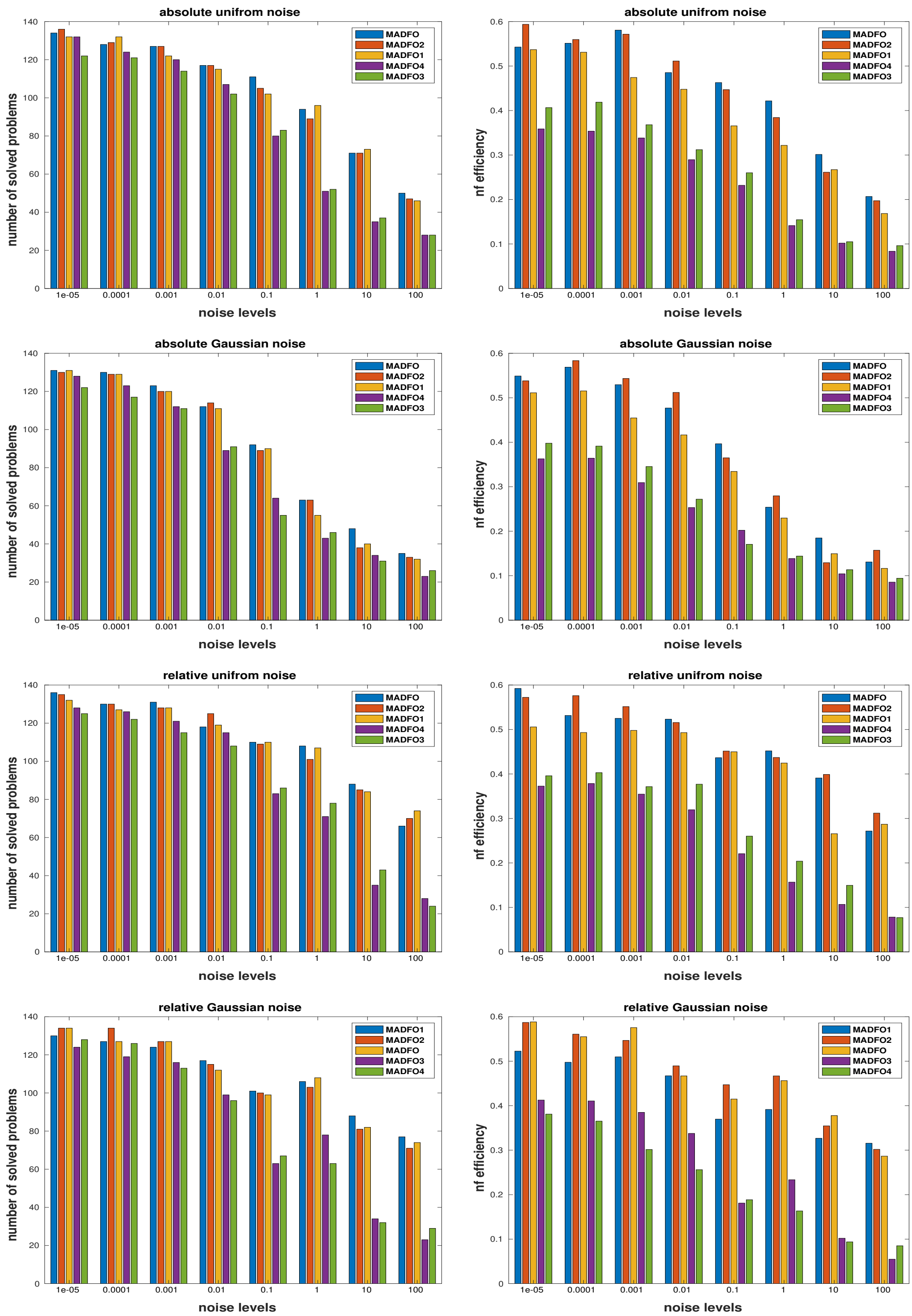

Figure 2: Noise profiles with respect to the noise levels for the robustness (left) and the `nf` efficiency (right) of `MADFO` and its four versions. Other details as Figure 1.

2 Classified recommendations by the kind and level of noise and the target accuracy

This section provides a recommendation for the type and level of noise and the target accuracy.

We summarize here our results from Figures 3–14. For all types of noise, `MADFO` is much more robust than the other solvers. When increasing the level of noise, `MADFO` not only stays in the first rank for robustness, but also becomes the first more efficient solver for large noise.

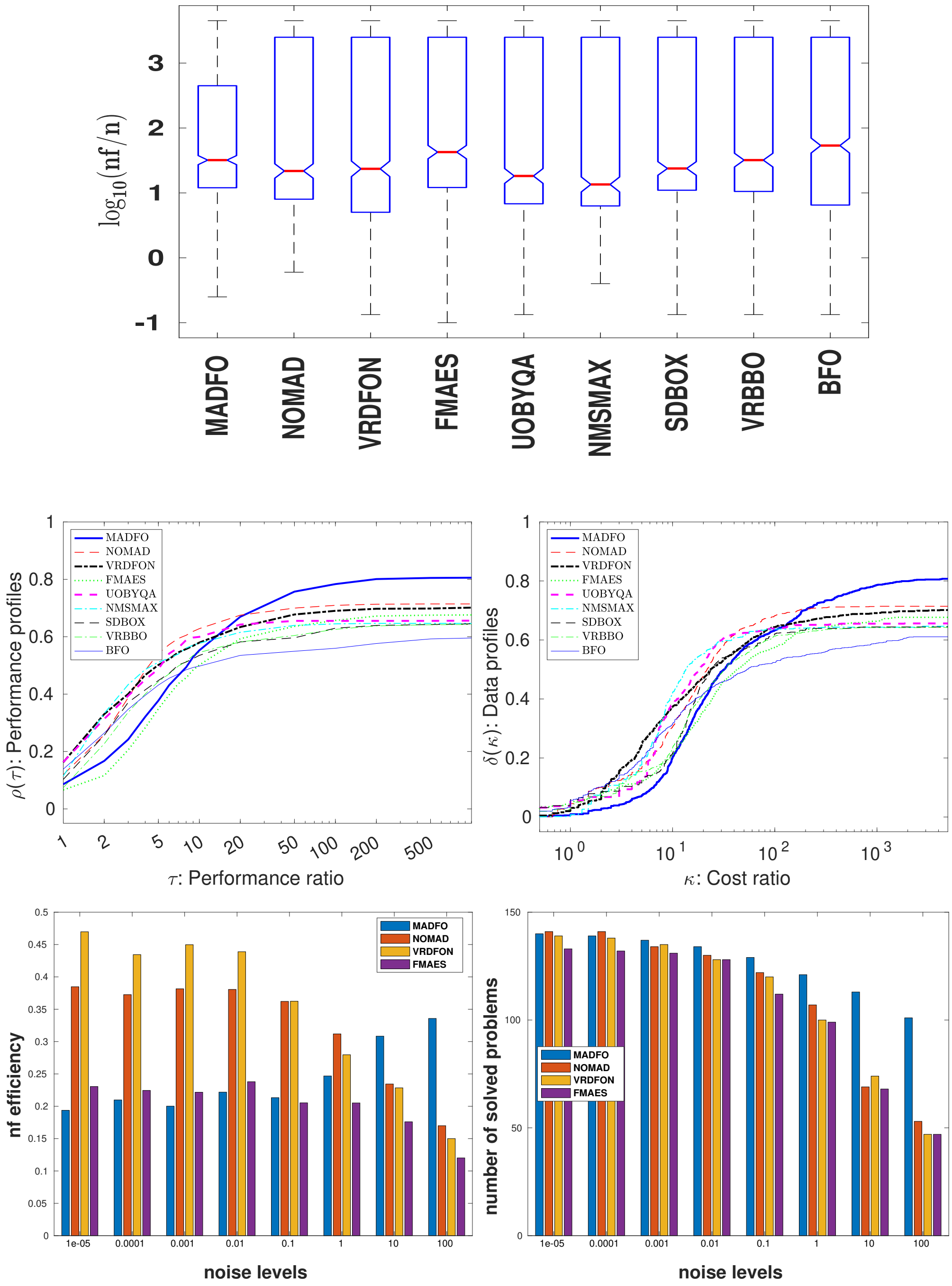

Figure 3: For the absolute uniform noise and the low target accuracy $\varepsilon = 10^{-2}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of **nf**, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

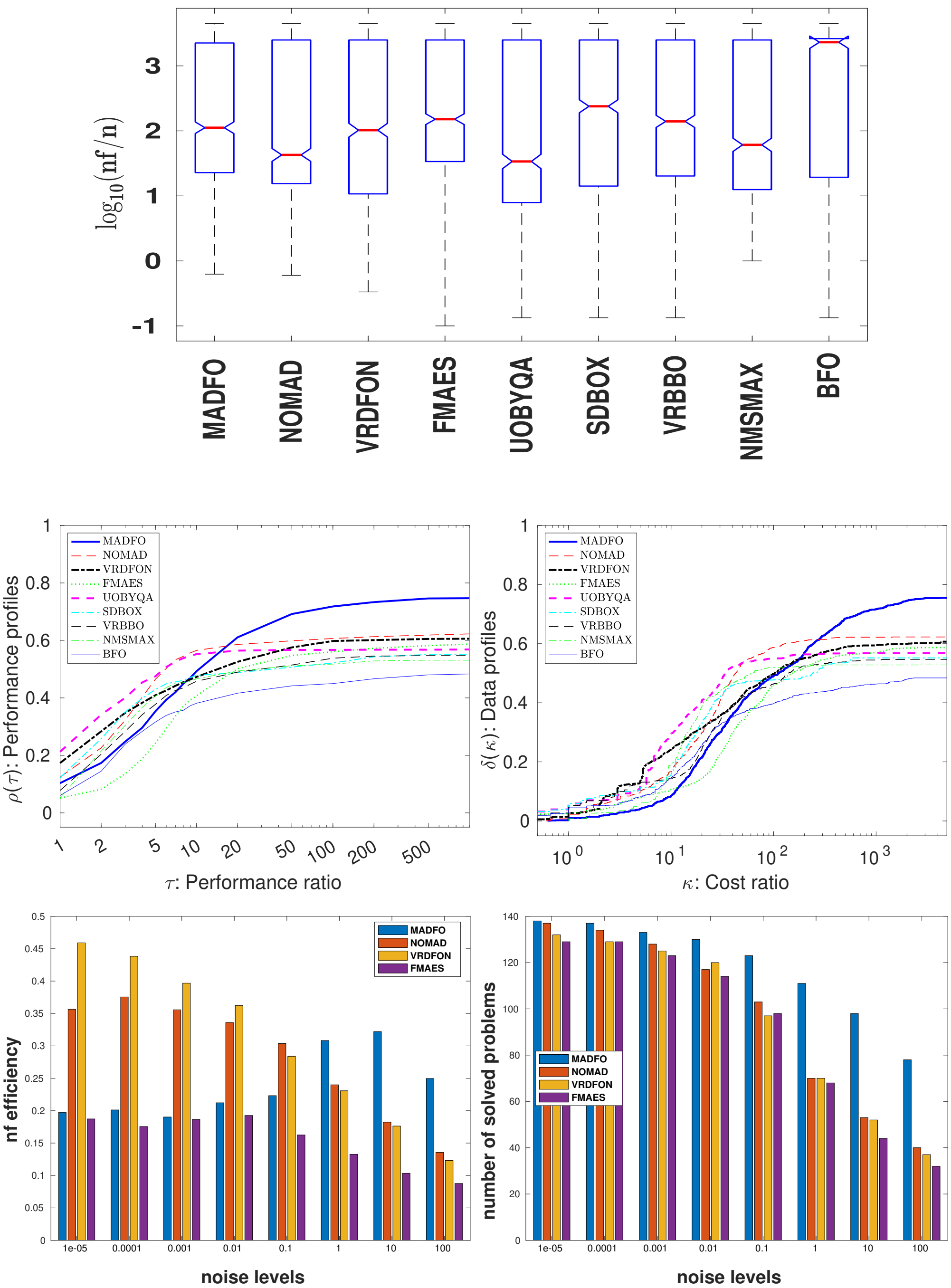

Figure 4: For the absolute uniform noise and the medium target accuracy $\varepsilon = 10^{-3}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

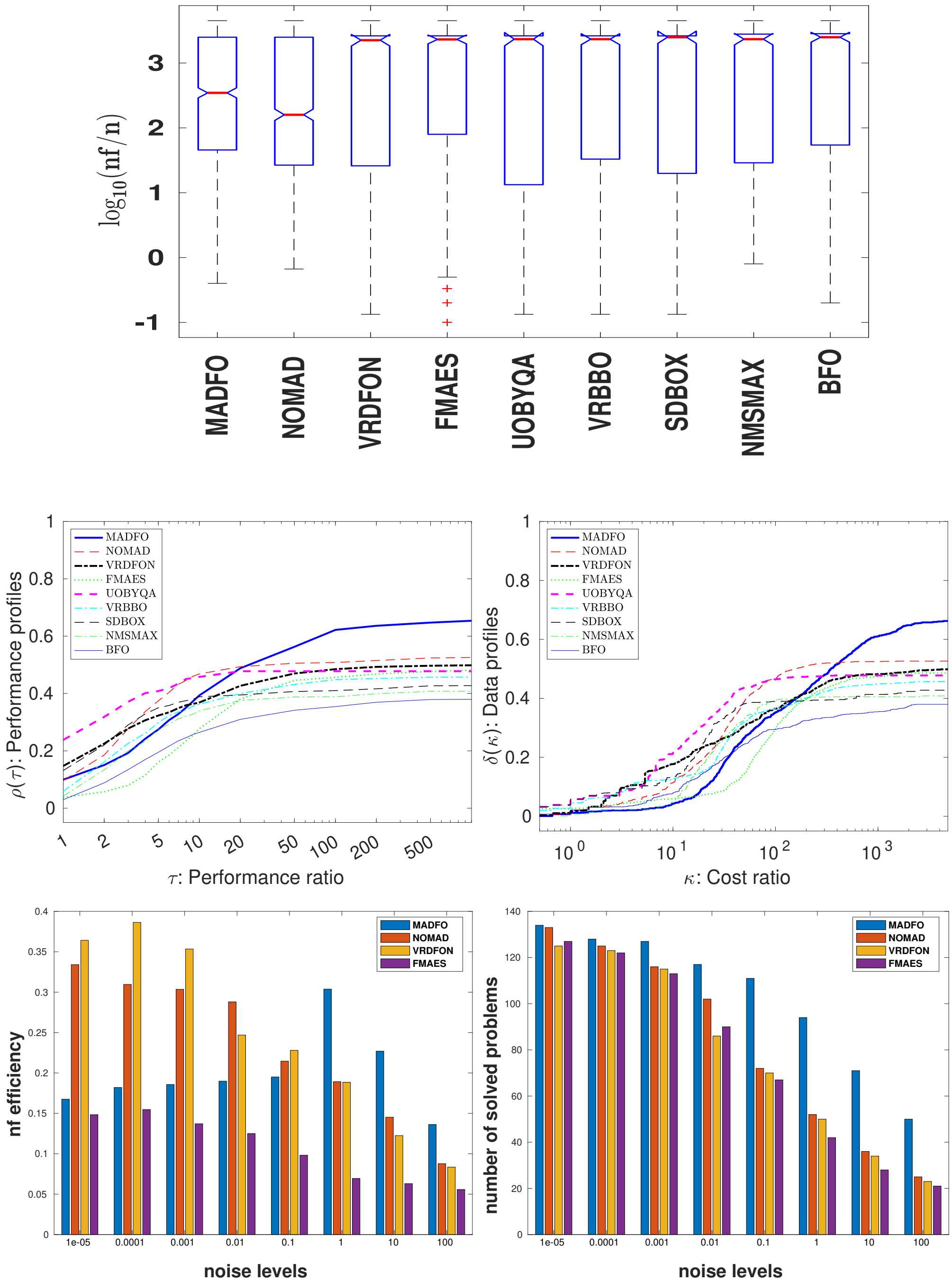

Figure 5: For the absolute uniform noise and the high target accuracy $\varepsilon = 10^{-4}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of **nf**, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

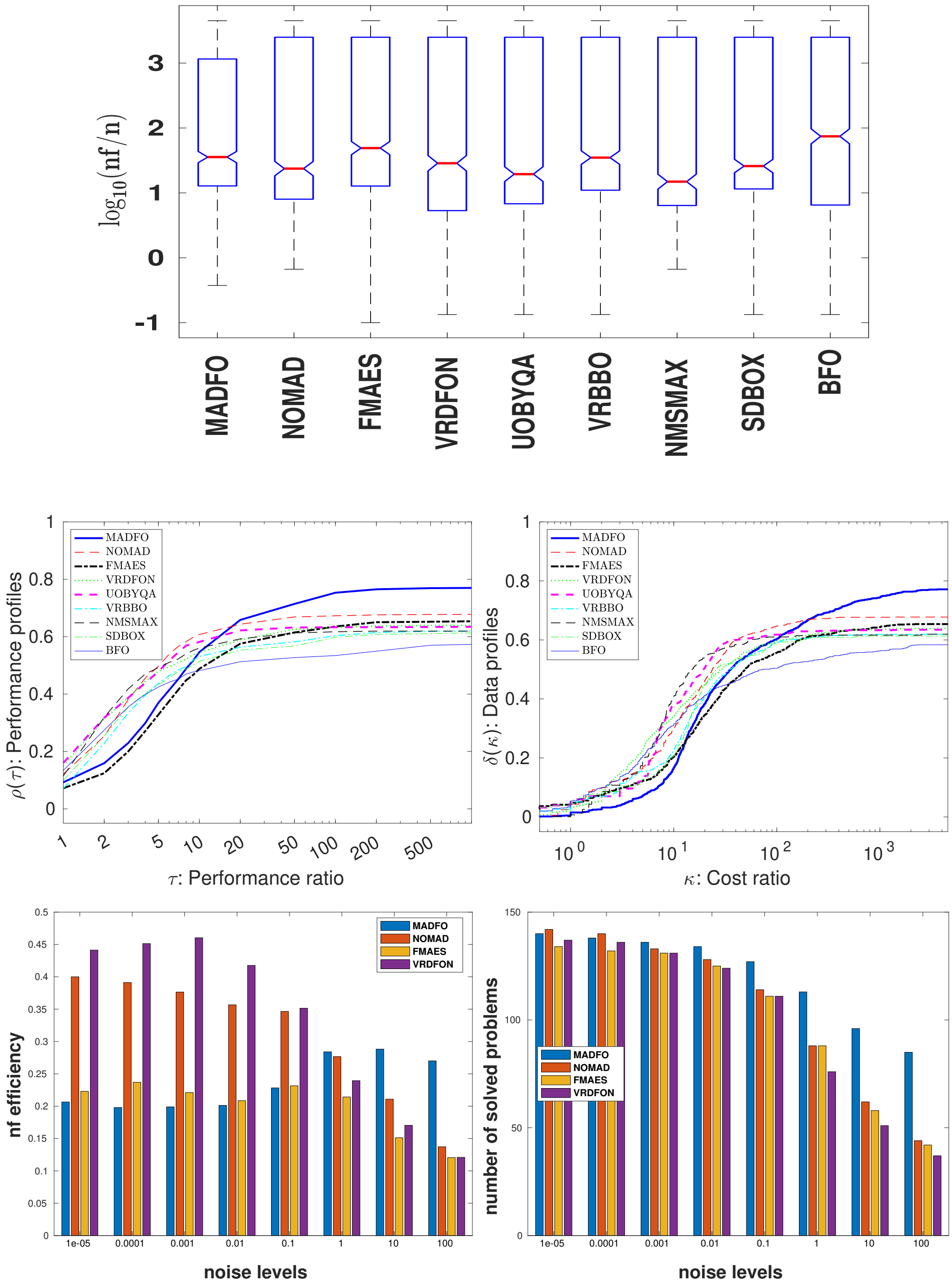

Figure 6: For the absolute Gaussian noise and the low target accuracy $\varepsilon = 10^{-2}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

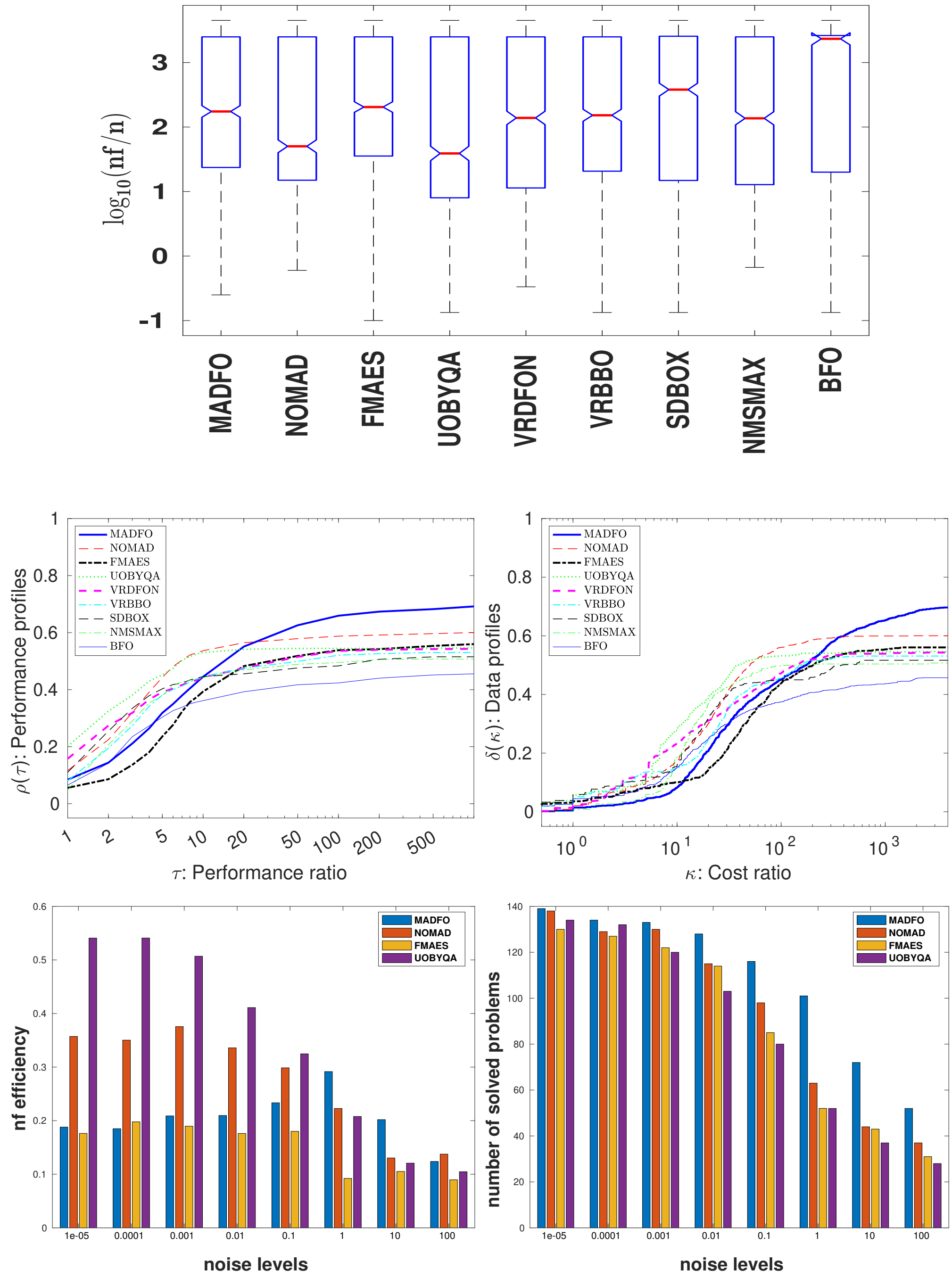

Figure 7: For the absolute Gaussian noise and the medium target accuracy $\varepsilon = 10^{-3}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

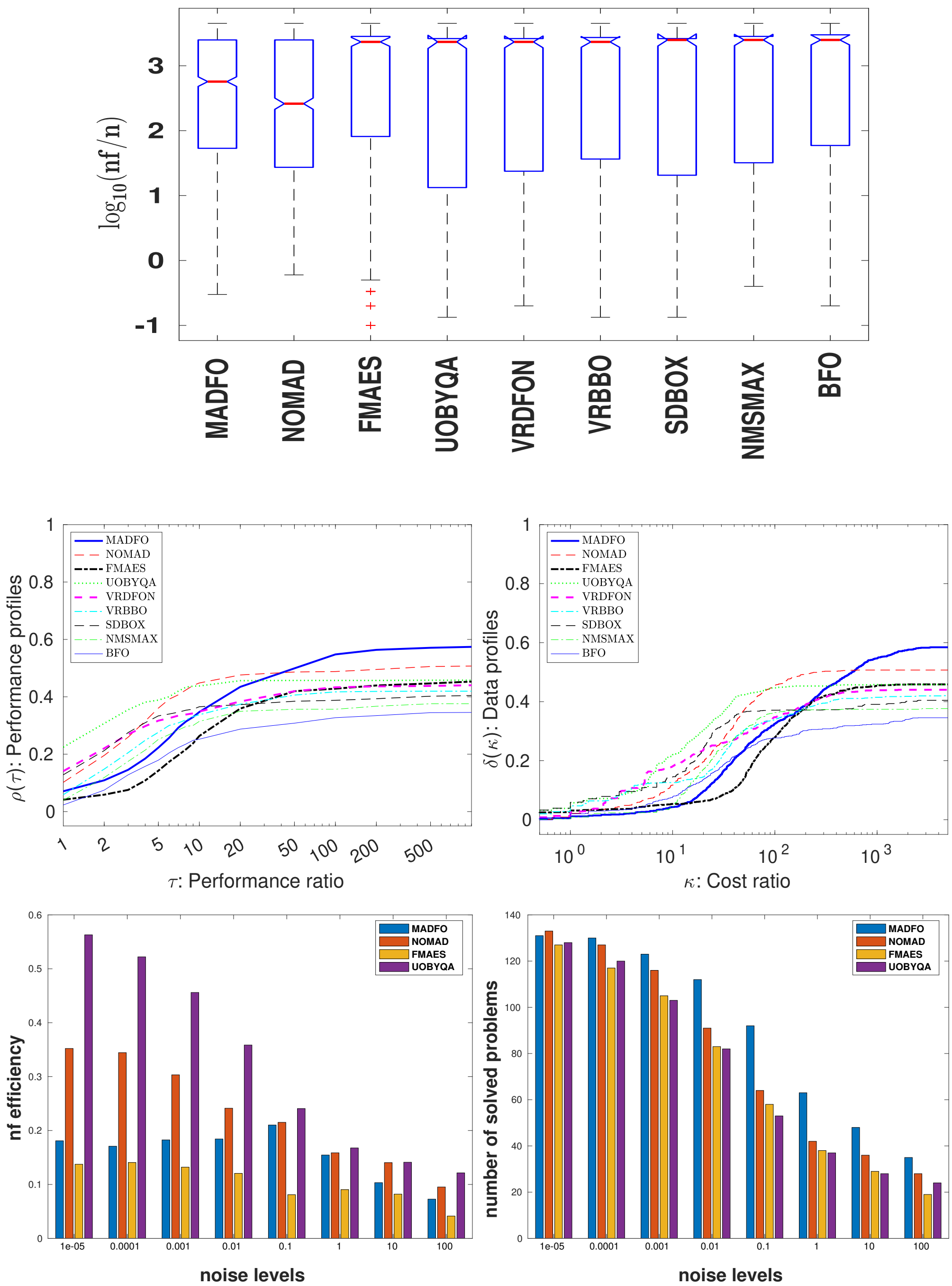

Figure 8: For the absolute Gaussian noise and the high target accuracy $\varepsilon = 10^{-4}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

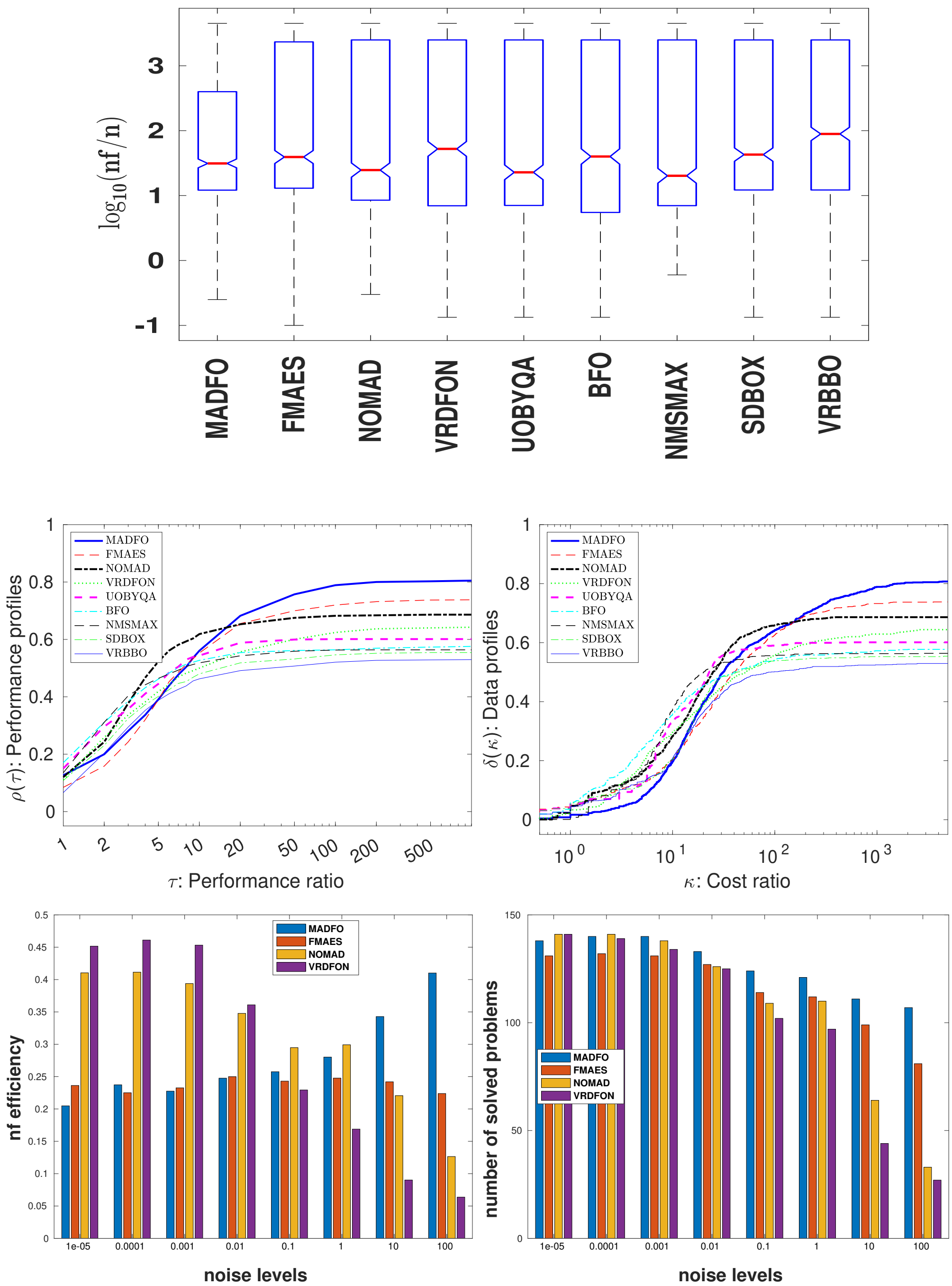

Figure 9: For the relative uniform noise and the low target accuracy $\varepsilon = 10^{-2}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

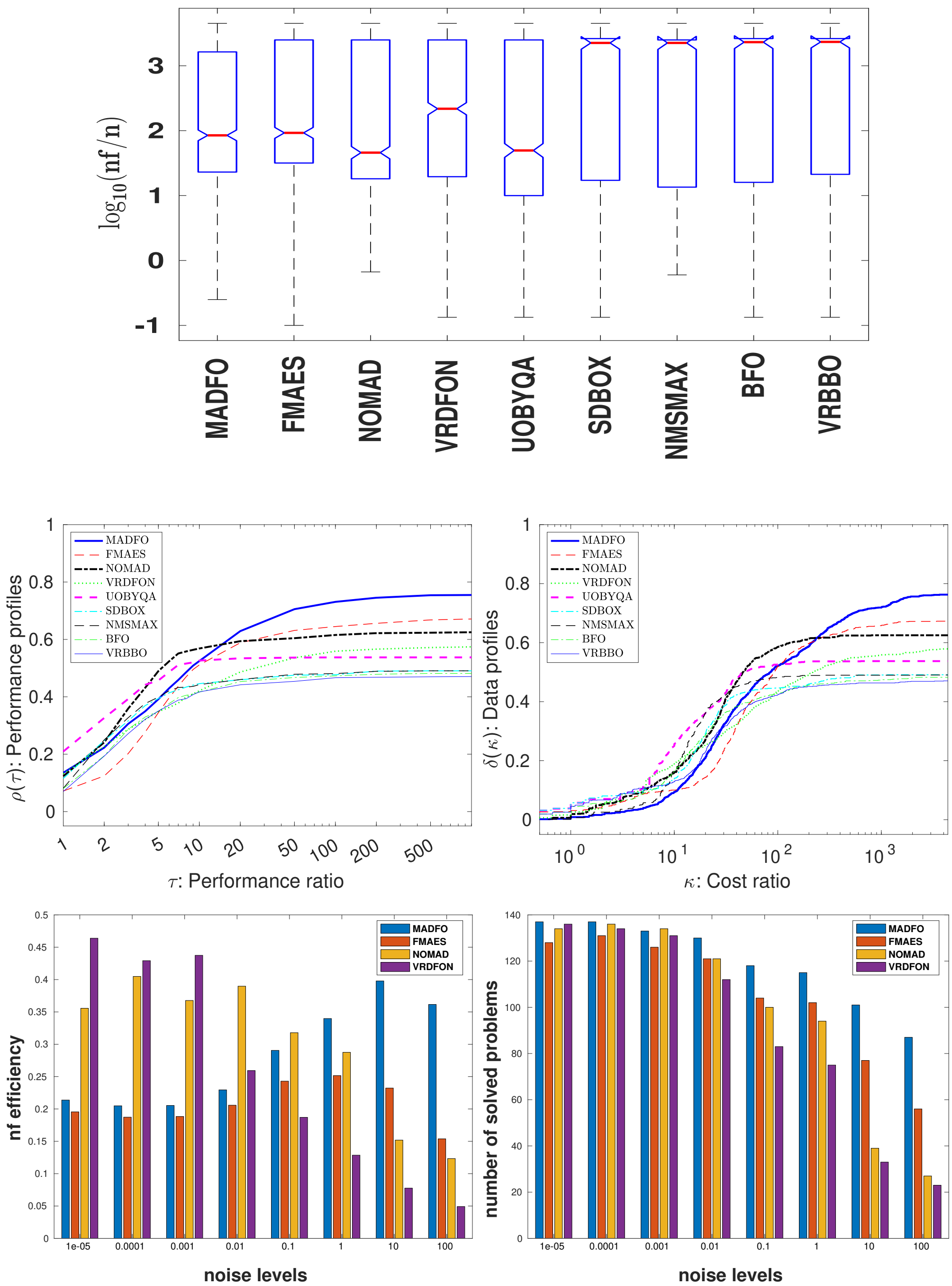

Figure 10: For the relative uniform noise and the medium target accuracy $\varepsilon = 10^{-3}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

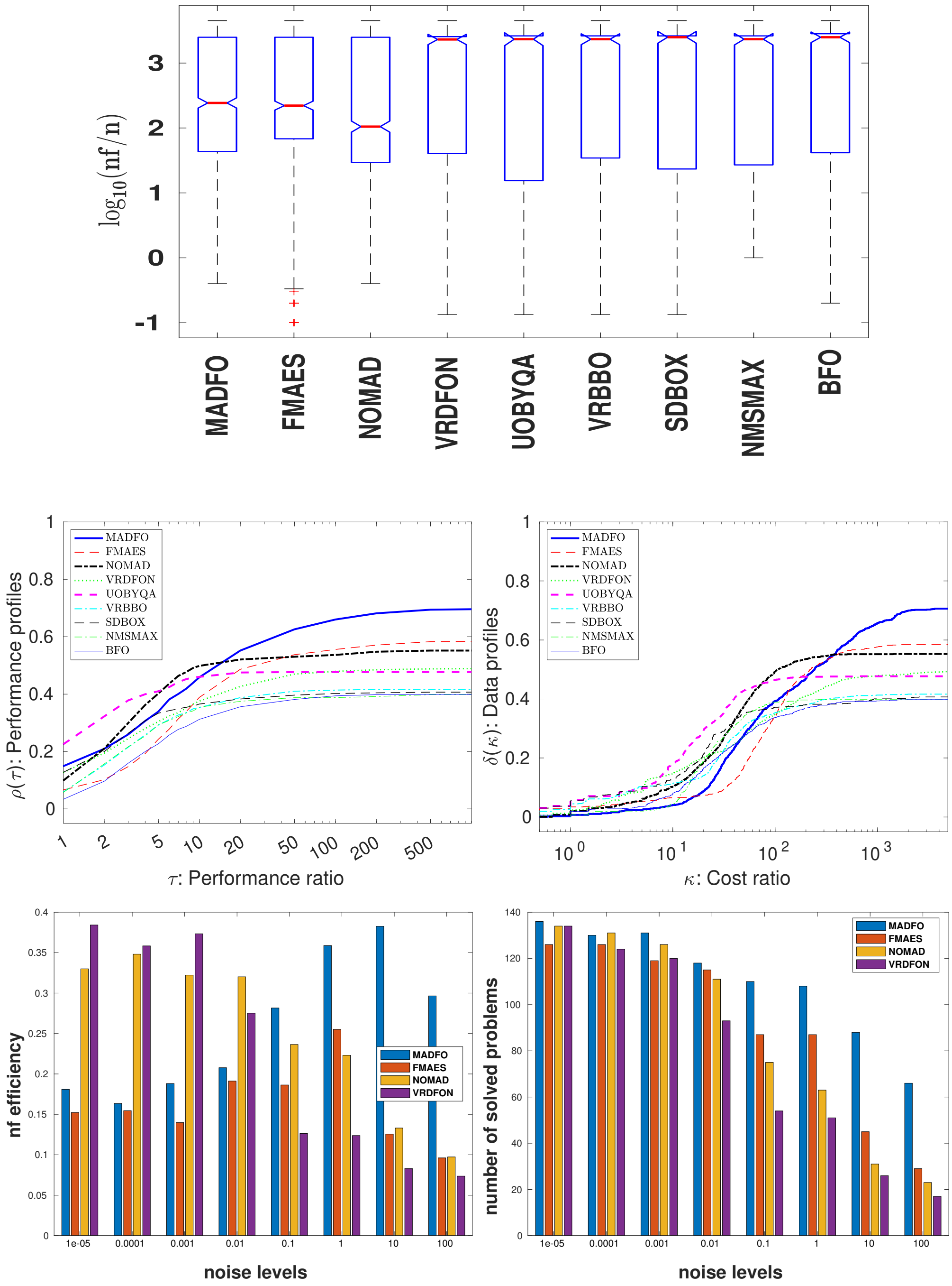

Figure 11: For the relative uniform noise and the high target accuracy $\varepsilon = 10^{-4}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

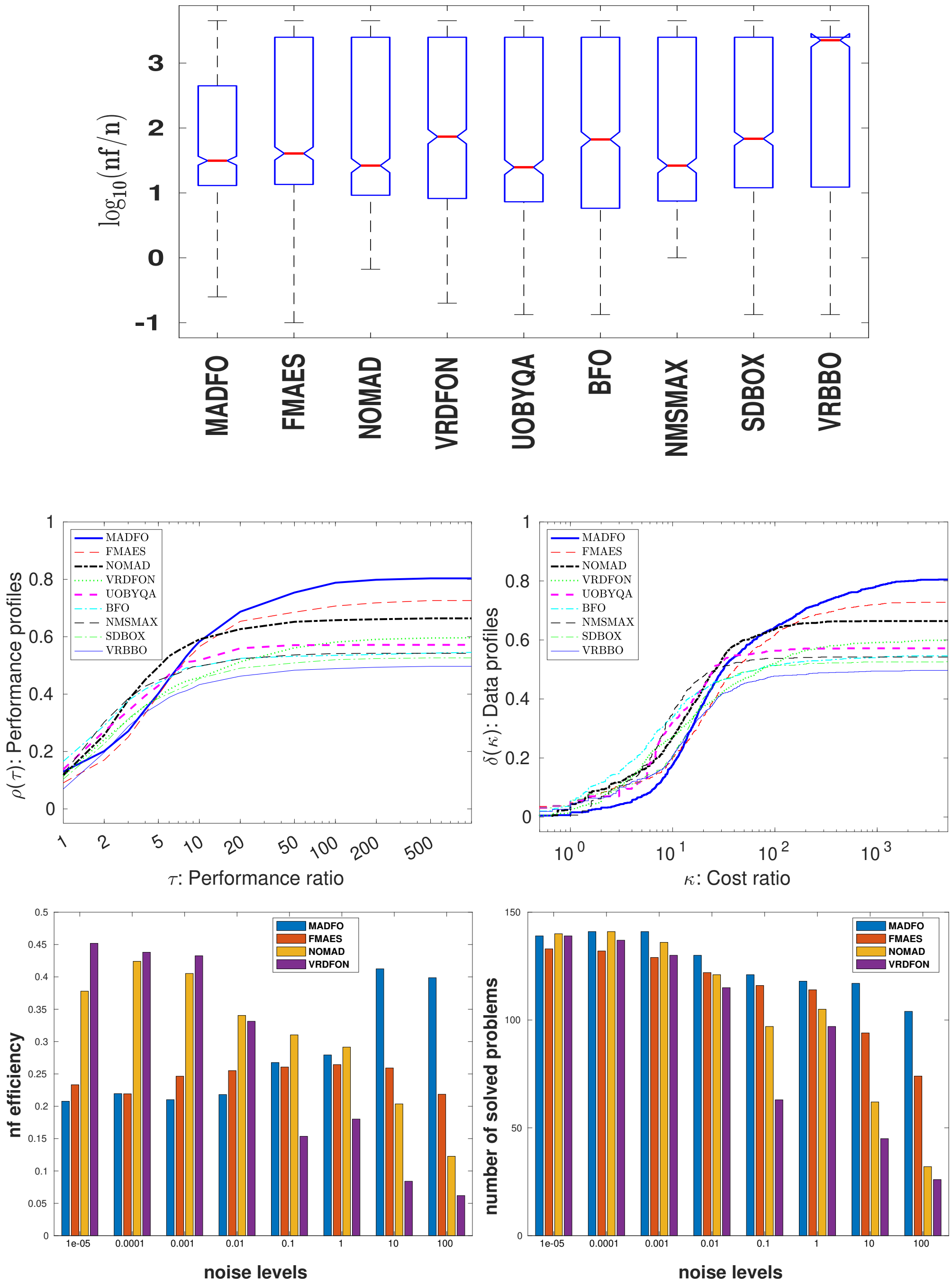

Figure 12: For the relative Gaussian noise and the low target accuracy $\varepsilon = 10^{-2}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

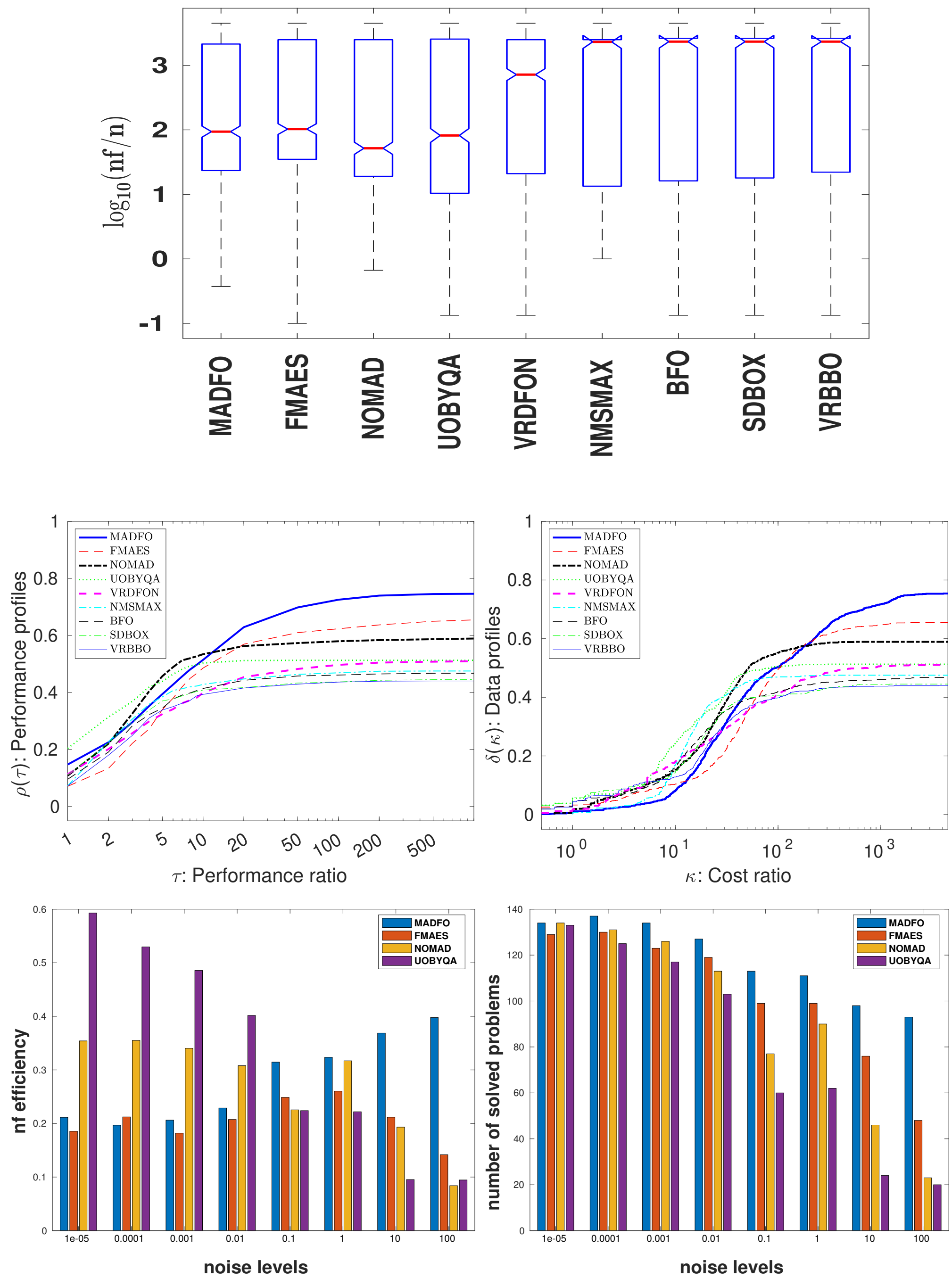

Figure 13: For the relative Gaussian noise and the medium target accuracy $\varepsilon = 10^{-3}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

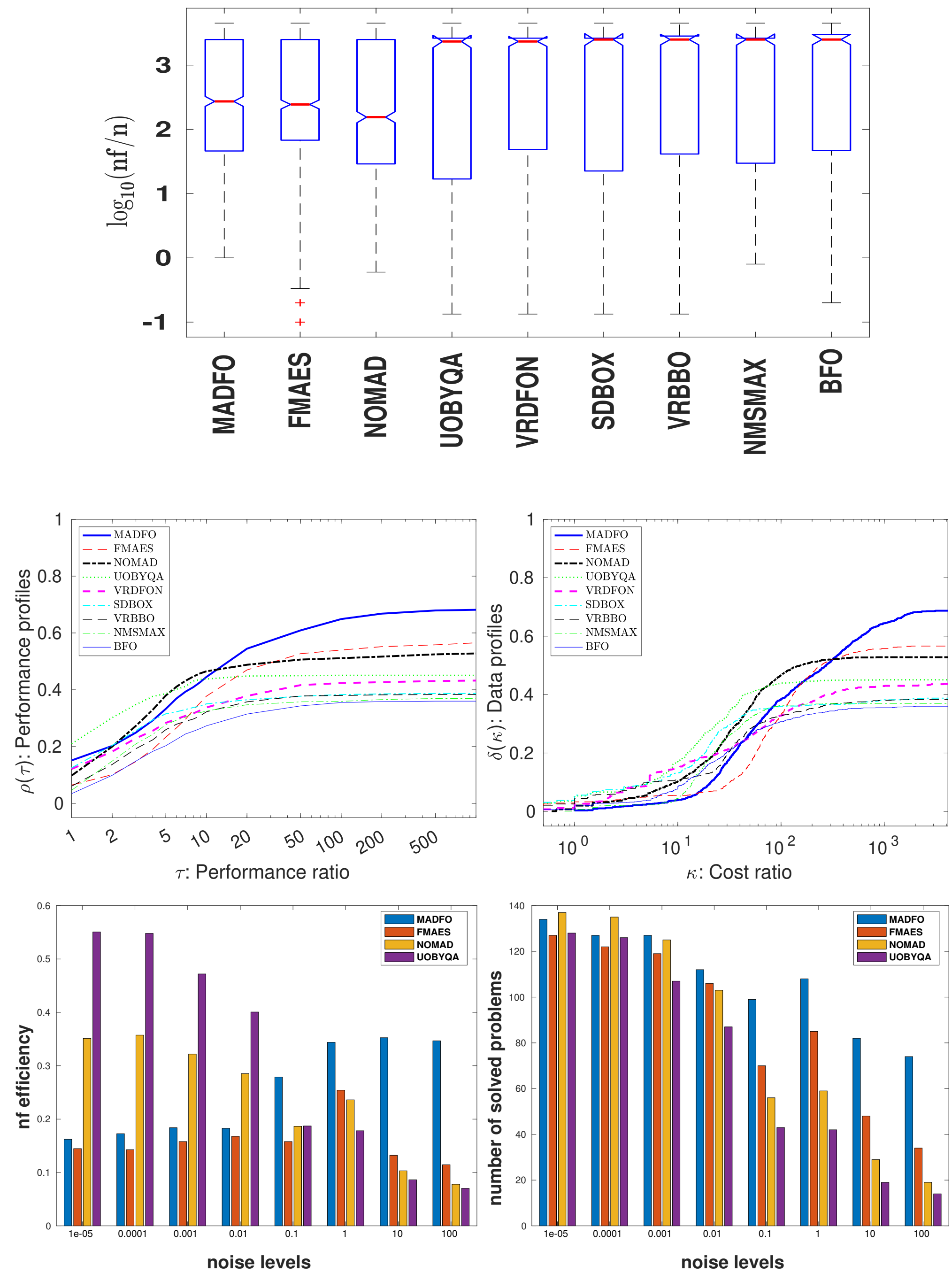

Figure 14: For the relative Gaussian noise and the high target accuracy $\varepsilon = 10^{-4}$: Box plots (first row), data and performance profiles (second row), noise profiles (third row, left) in terms of `nf`, and noise profiles (third row, right) in terms of the number of solved problems for the four more robust solvers.

References

[1] Kimiaei, M., Neumaier, A.: Effective matrix adaptation strategy for noisy derivative-free optimization. Accepted for publication in *Math. Program. Comput.* (2024)