NEURAL INFORMATION
PROCESSING SYSTEMS

sAIfer Lab
Joint lab on Safety and Security of AI

TransferBench: Benchmarking Ensemble-based Black-box Transfer Attacks

Fabio Brau, Maura Pintor, Antonio Emanuele Cinà, Raffaele Mura, Luca Scionis,
Luca Oneto, Fabio Roli, Battista Biggio

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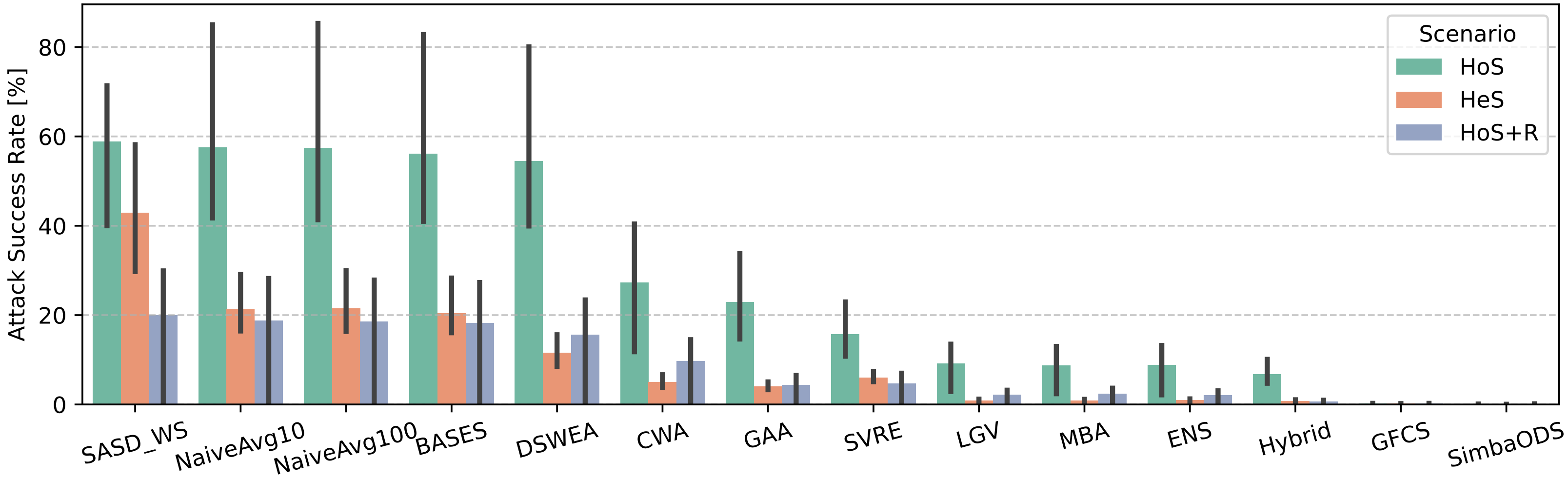
Benchmarking Attacks on Standard Scenarios

TransferBench

Benchmarking Ensemble-based Black-box
Transfer Attacks

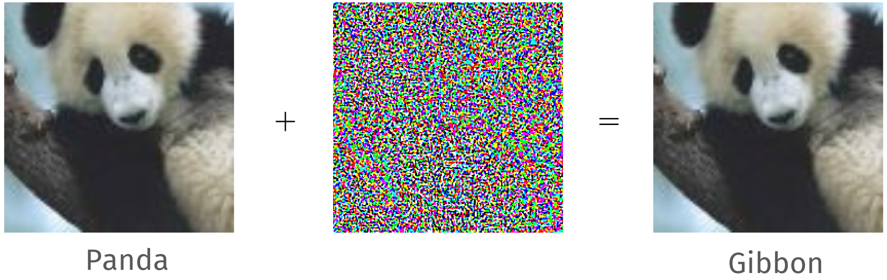


Attacking Classification Models

Gradient-Based Perturbation

$$x^* = x - \varepsilon\,\mathrm{sgn}\,\boxed{\nabla_x \mathcal{L}(g_\theta(x), y)}$$

Gradient based on the target



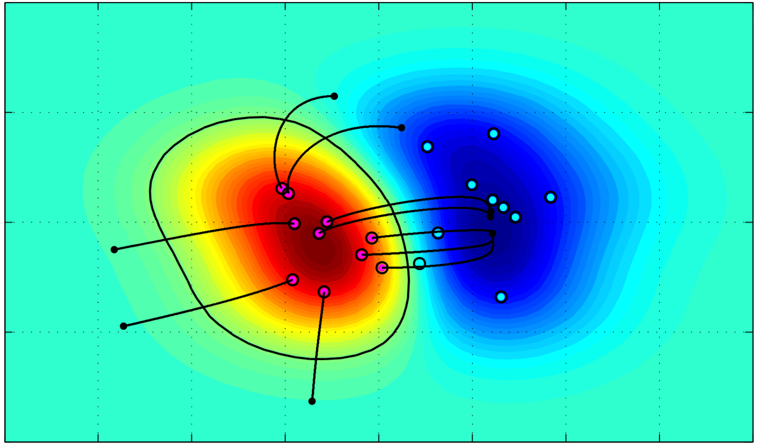
Goodfellow, Ian J., et el. "Explaining and harnessing adversarial examples.”. ICLR, 2015.

Attacking Classification Models

Adversarial Attacks as Minimum Problem

$$
\begin{aligned}
x^* \in \operatorname*{argmin}_{x} \quad & \boxed{\mathcal{L}(g_\theta(x), y)} \\
\text{s.t.} \quad & d(x, x_0) \leq \varepsilon
\end{aligned}
$$

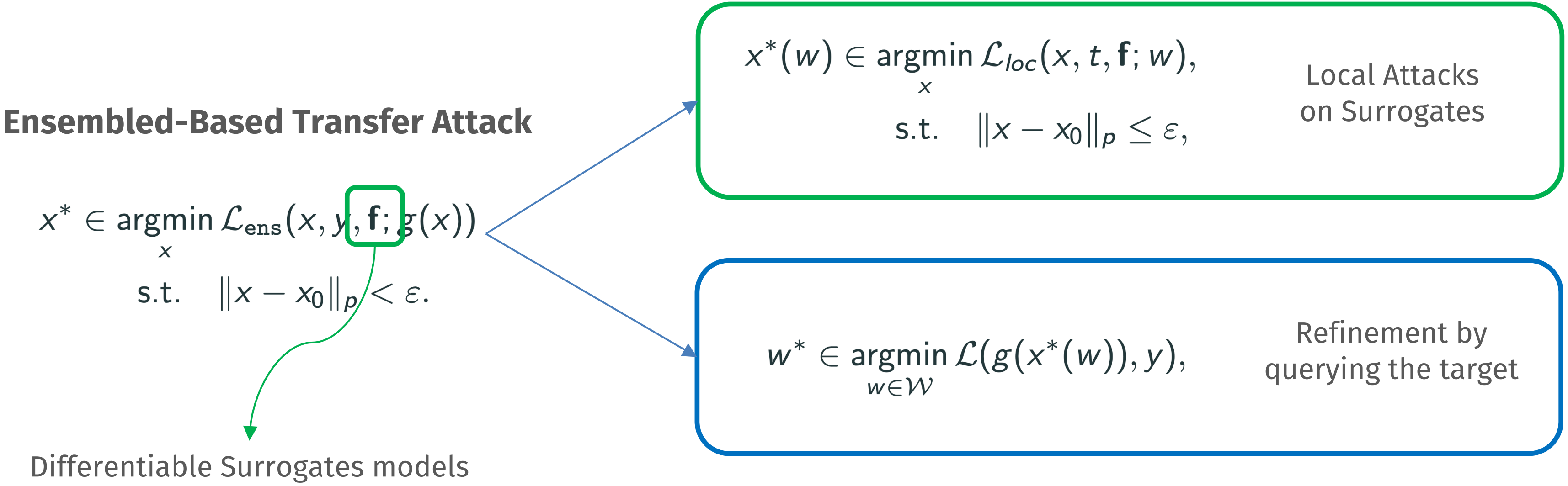
Assuming Differentiable Objective



Biggio, Battista, et al. "Evasion attacks against machine learning at test time." ECML-PKDD, 2013.

Ensemble-based Attacks Formulation

With a Black-box Target, gradient is not accessible ~~$\nabla_x \mathcal{L}(g_\theta(x), y)$~~



Ensembled-Based Transfer Attack

$$x^* \in \underset{x}{\operatorname{argmin}}\, \mathcal{L}_{\mathtt{ens}}(x, y \boxed{, \mathbf{f};} g(x))$$
$$\text{s.t.} \quad \|x - x_0\|_p < \varepsilon.$$

Differentiable Surrogates models

$$x^*(w) \in \underset{x}{\operatorname{argmin}}\, \mathcal{L}_{loc}(x, t, \mathbf{f}; w),$$
$$\text{s.t.} \quad \|x - x_0\|_p \leq \varepsilon,$$

Local Attacks on Surrogates

$$w^* \in \underset{w \in \mathcal{W}}{\operatorname{argmin}}\, \mathcal{L}(g(x^*(w)), y),$$

Refinement by querying the target

Coverage of the Benchmark and Motivation

Which is the best Ensemble-Based Transfer Attack ?

Compared Methods

Attack	Venue	m
SubSpace	NeurIPS 2019	3
SimbaODS	NeurIPS 2020	4
Hybrid	Usenix 2020	3
GFCS	ICLR 2022	4
BASES	BASES 2022	20
GAA	PR 2024	4
DSA	Usenix 2024	3
DSWEA	PR 2025	10

Large pool of surrogates has been sometime used !!

Flaws of Current Method

- Biased Surrogates
- Weak Targets
- Query Effectiveness

How TransferBench Addresses the Gaps

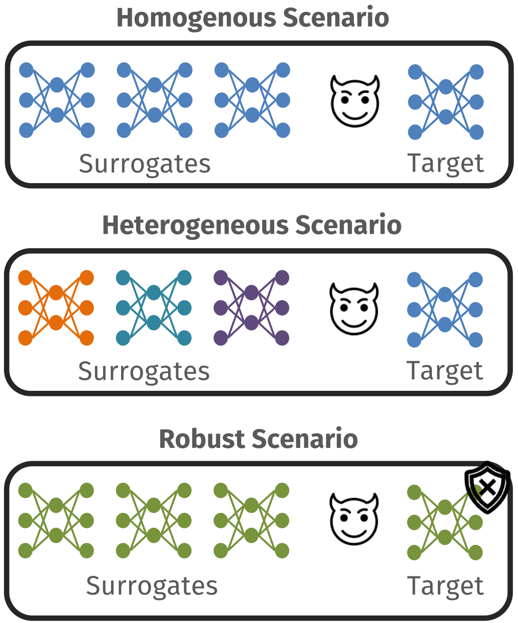
Flaws

Mitigations

Biased Surrogates

Weak Targets

Scenarios



Homogenous Scenario

Heterogeneous Scenario

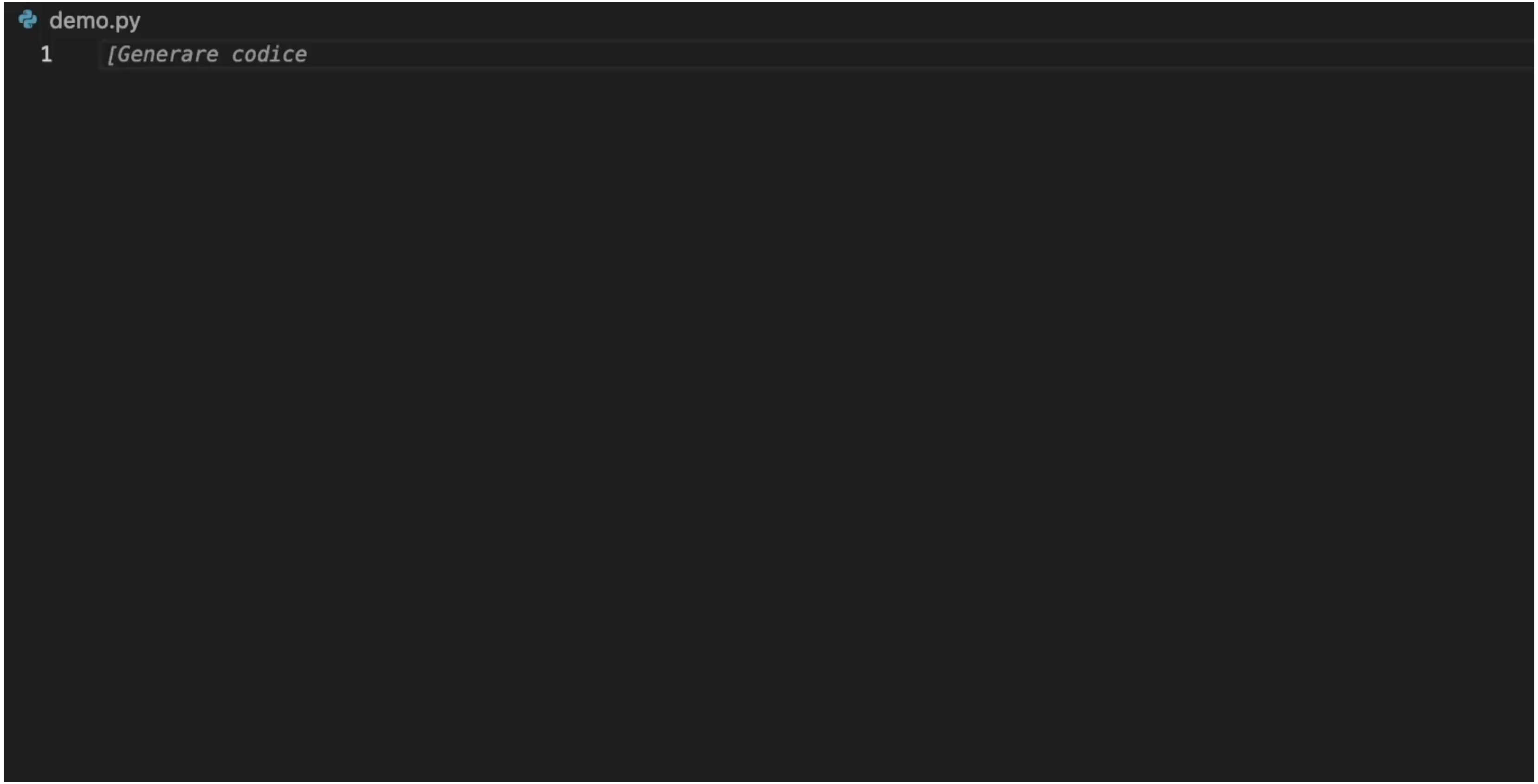
Robust Scenario

Query Effectiveness

Baselines

Query-free Methods and Naïve Average

Transferbench Ease of Use



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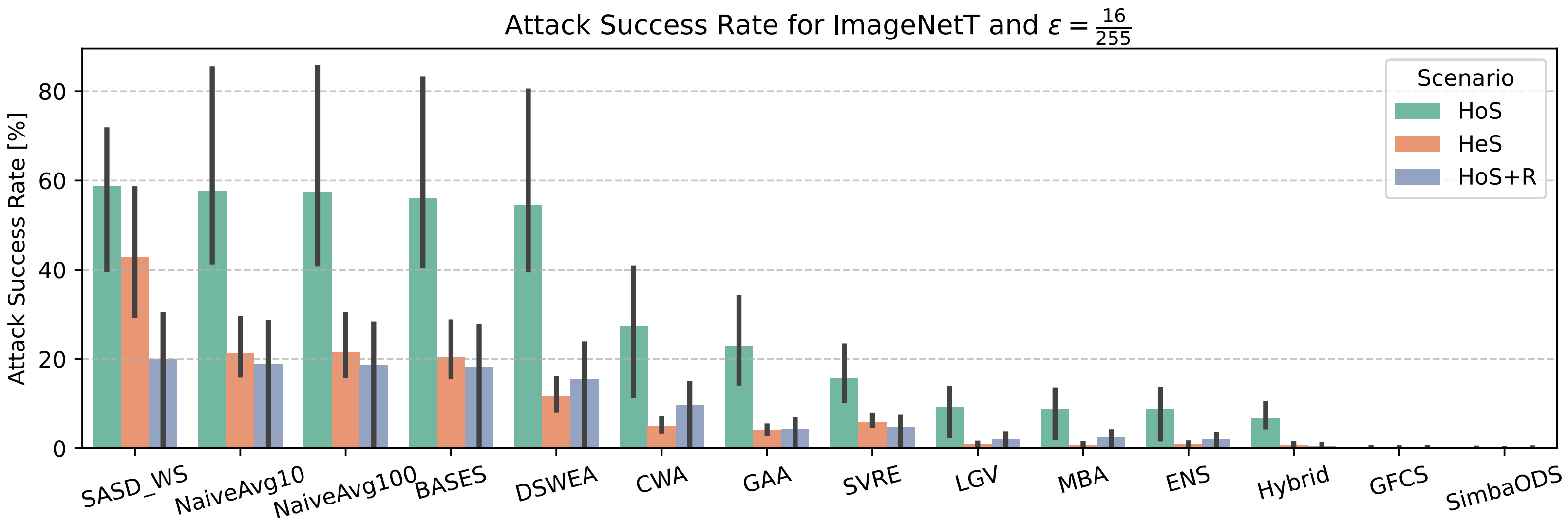
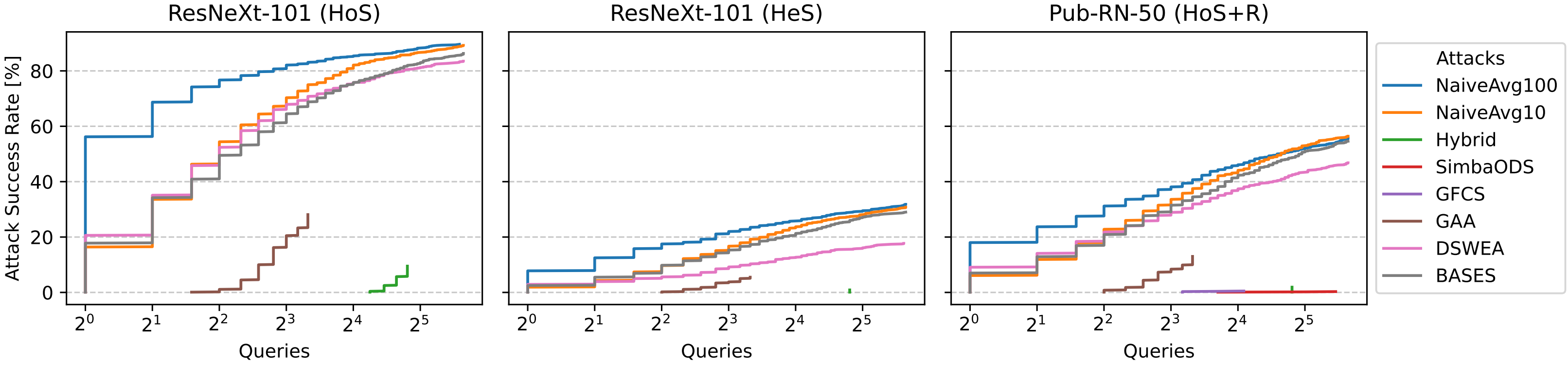
Main Results



- In all the Scenarios, current methods are worst than baselines
- Attacking Robust Models is still an open problem

Main Results



Querying the target does not really contribute to refine the attack

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TransferBench

Benchmarking Ensemble-based Black-box Transfer Attacks

Paper

Code

SEC4AI4SEC

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