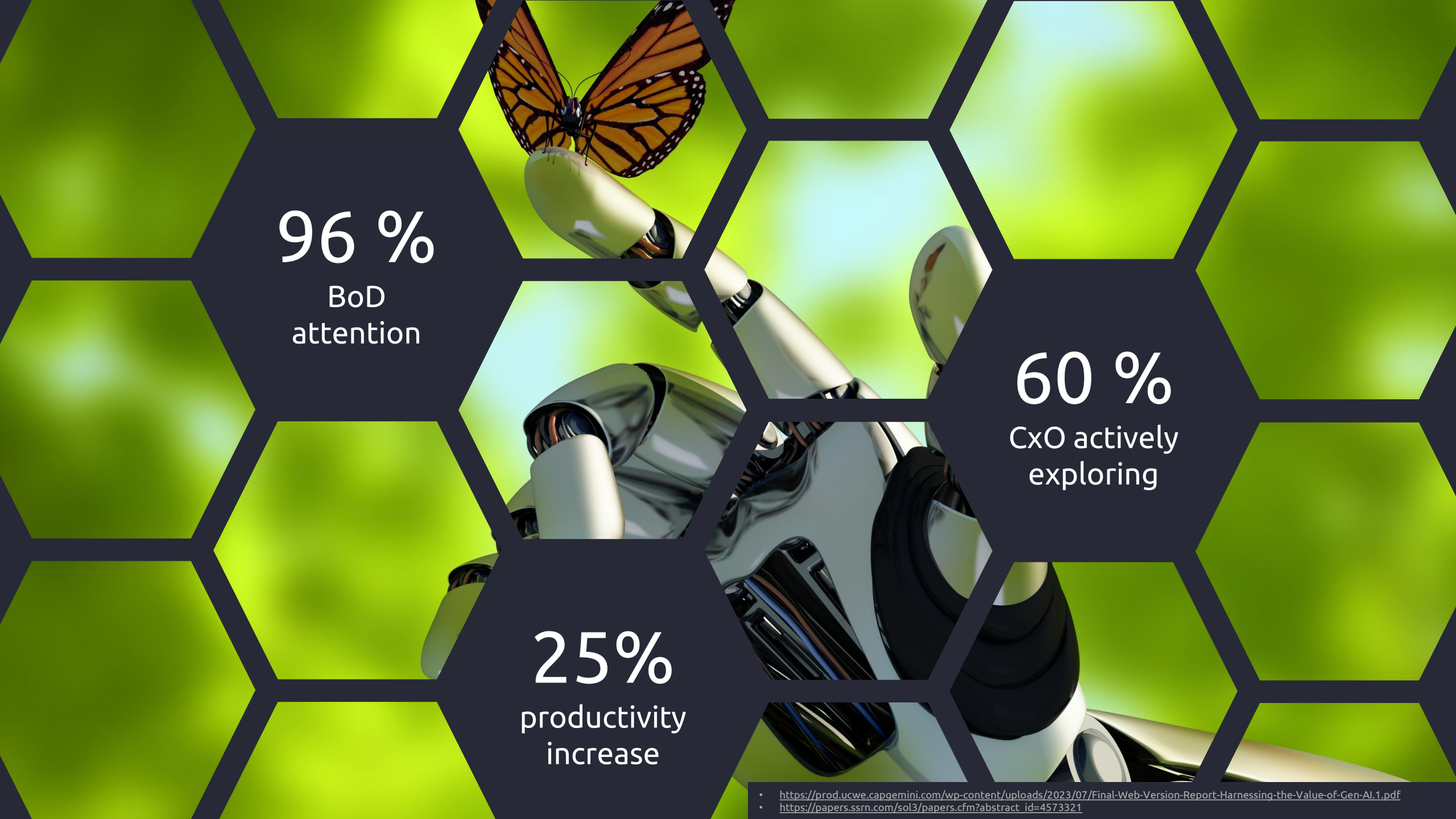
GEN AI IN I&M

How can Generative AI impact future inspection and maintenance?



96 %
BoD
attention

60 %
CxO actively
exploring

25%
productivity
increase

- https://prod.ucwe.capgemini.com/wp-content/uploads/2023/07/Final-Web-Version-Report-Harnessing-the-Value-of-Gen-AI.1.pdf
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4573321

USE CASES AND APPLICATIONS WITHIN INSPECTION & MAINTENANCE

Knowledge Management Communication & Training

Report generation and translation

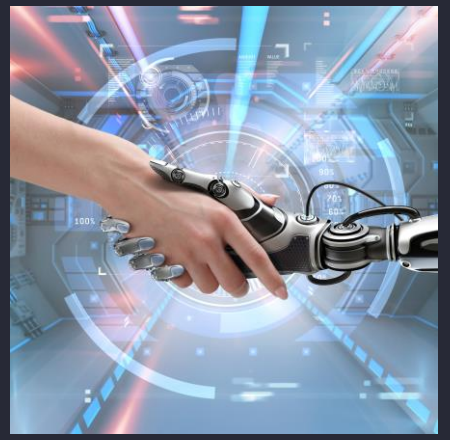
Data collection and summarisation

Robotics training

Visual- language-action models

Inspection & Maintenance assistance

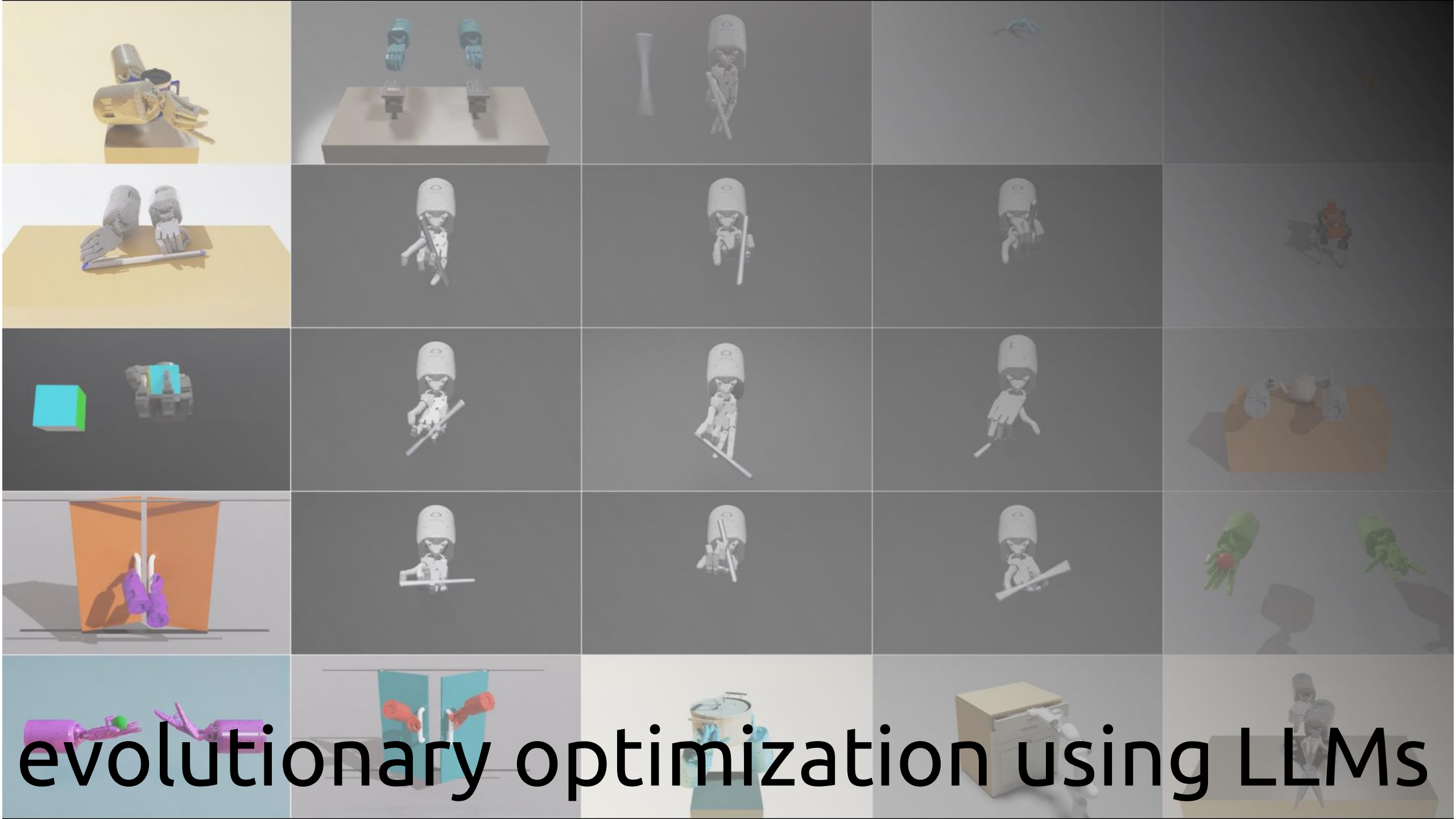
Inspection & Maintenance robotics



For both application types, we see a profound potential for a positive effect on democratisation

CAPGEMINI AI FUTURES LAB

AUTOENCODERS (VAE) & GENERATIVE ADVERSARIAL NETWORKS (GAN)	**Meta HiFi-GAN vocoder, OpenAI Whisper**
MULTIMODAL AND VISION-LANGUAGE-ACTION (VLA) MODELS	**SeamlessM4T, GPT-4V, Google Gemini, RT-2**
DIFFUSION MODELS **Generate images, sounds, texts**	**Stable Diffusion XL, Midjourney 5.x, Dall-E 3, AIVA**
TRANSFORMER MODELS (GPT) **Interprete & generate text, speech, patterns, code, objects, etc**	**GPT-3.5, GPT-4, Llama, PaLM 2, Falcon, WatsonX**


evolutionary optimization using LLMs

Environment Code

```
class ShadowHandPenSpin(VecTask):
  def compute_observations(self):
    self.obj_pose = ...
    self.obj_pos = ...
    self.obj_rot = ...
    self.obj_linvel = ...
    self.obj_angvel = ...

    self.tgt_pose = ...
    self.tgt_pos = ...
    self.tgt_rot = ...

    self.fingertip_state = ...
    self.fingertip_pos = ...

    self.compute_full_state()

  def compute_full_state(self):
    ...
```

Task Description

```
To make the shadow hand spin the pen
to a target orientation
```

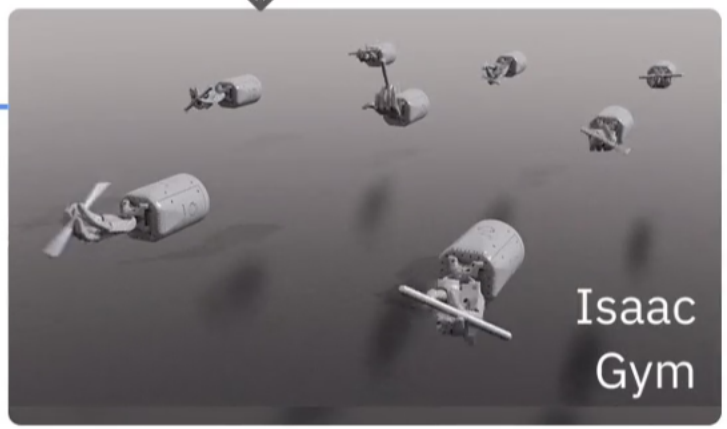
Coding LLM (GPT 4)

Reward Candidate Sampling

```
def compute_reward(
  obj_rot, obj_angvel, ...
):
  ...
  # Angular velocity penalty
  av_norm = torch.norm(obj_angvel)
  av_penalty = torch.where(
    av_norm > 2.0,
    torch.exp(av_norm - 2.0)
  )
  ...
```

Eureka

GPU-Accelerated RL

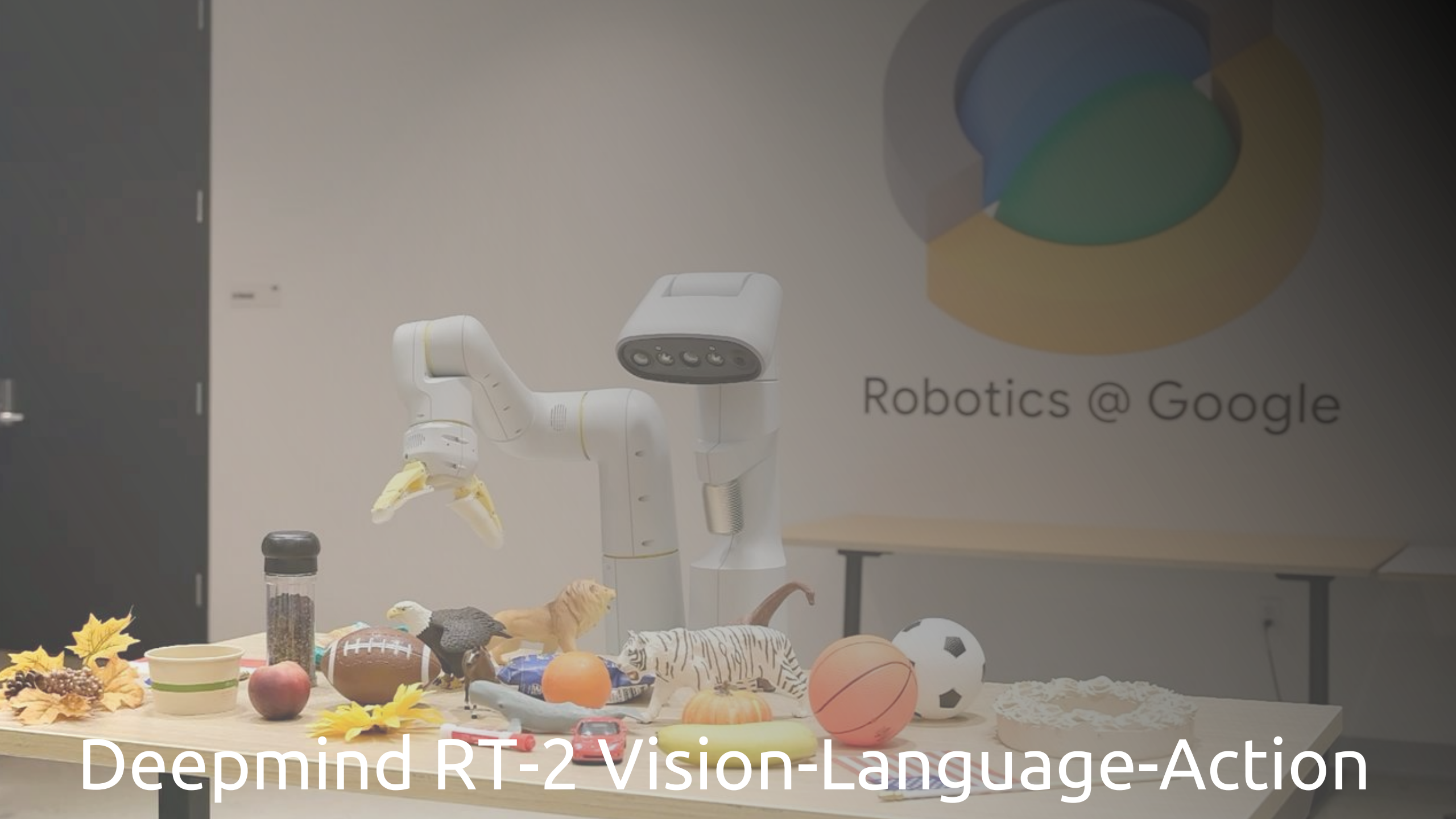


Reward Reflection

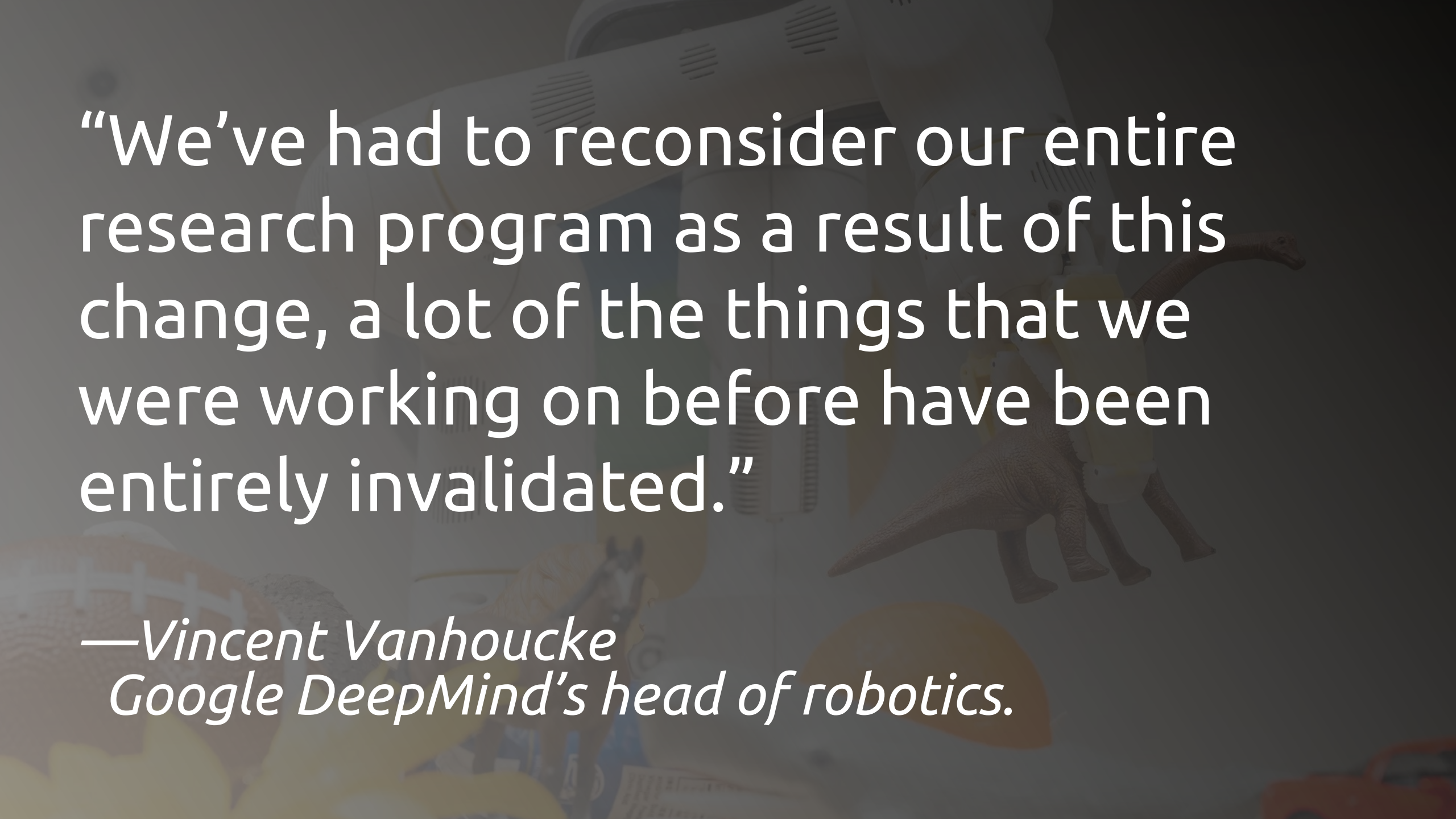
```
We trained a RL policy using the
provided reward function code...
av_penalty: ['0.02', '0.05',
'0.05', '0.04', '0.03', ...]
success_rate: ['0.00', '0.38',
'1.57', '3.01', '3.95', ...]
Please carefully analyze the policy
feedback and provide a new, improved
reward function...
```

Query with Feedback

Eureka achieves human-level reward design



Deepmind RT-2 Vision-Language-Action



“We’ve had to reconsider our entire research program as a result of this change, a lot of the things that we were working on before have been entirely invalidated.”

—*Vincent Vanhoucke*
Google DeepMind’s head of robotics.

We believe that Generative AI shows great promise in lowering cost of training complex tasks, and allowing for natural language control of robotics using LLMs.

There are however many hurdles from research to real world applications:

- Data Availability and Quality
- Generalization
- Computational Resources
- Safety and Reliability
- Scalability …and more