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LABORATOIRE
NATIONAL
DE MÉTROLOGIE
ET D'ESSAIS



ENHANCING CONTROL OF GENERATIVE AI THROUGH METROLOGY

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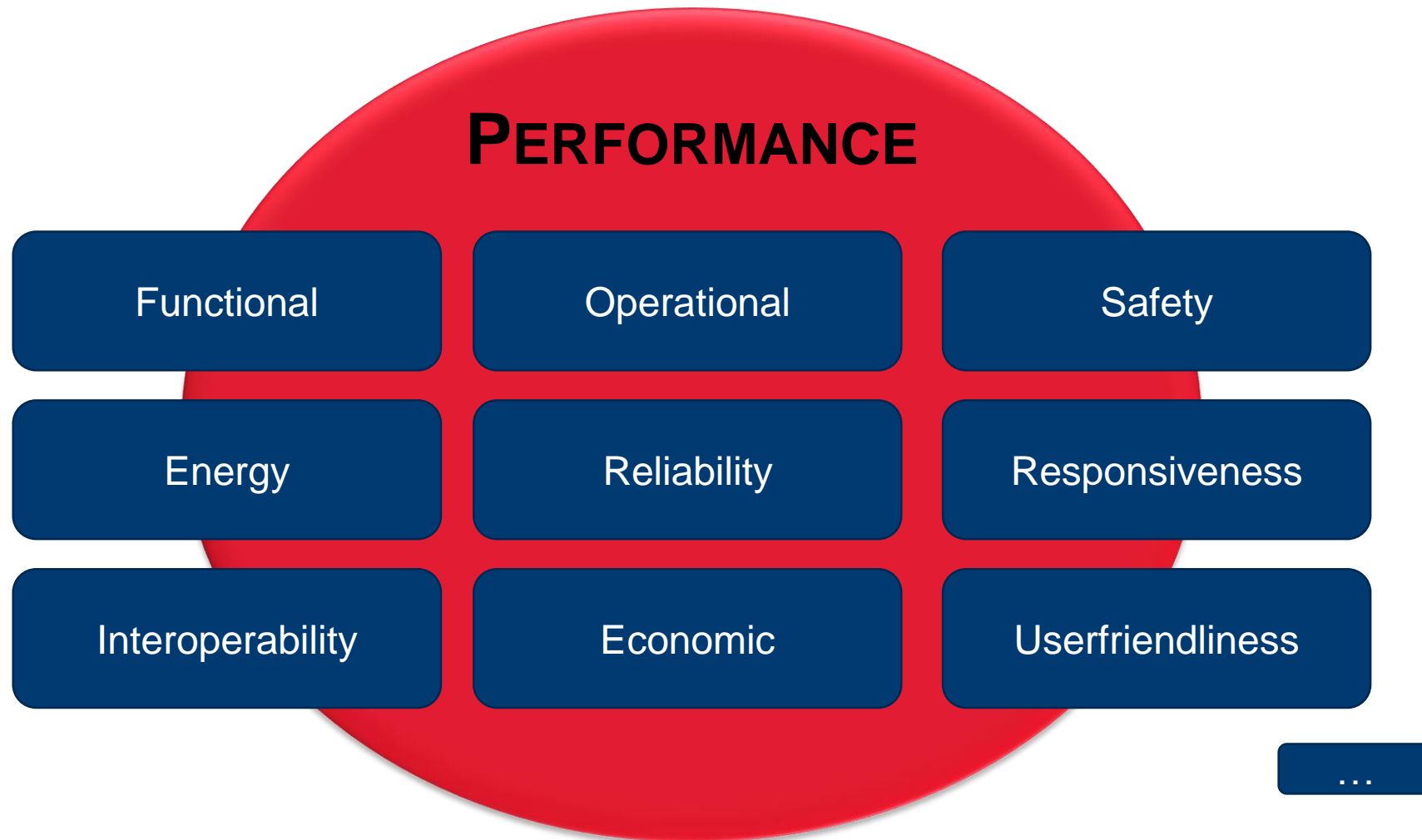
23rd meeting of NMI Directors, October 17th 2024

CURRENT CHALLENGES ON THE SCENE OF AI

- AI Act and other international regulations
- Conformity assessment, certification, CE marking
- Safety, trust, ethics, societal impact
- Speed of evolution (generative AI, frontier models, etc.)
- Large industrial coverage of AI

A need for reliable means to estimate performance of AI

AI PERFORMANCE



GENERATIVE AI

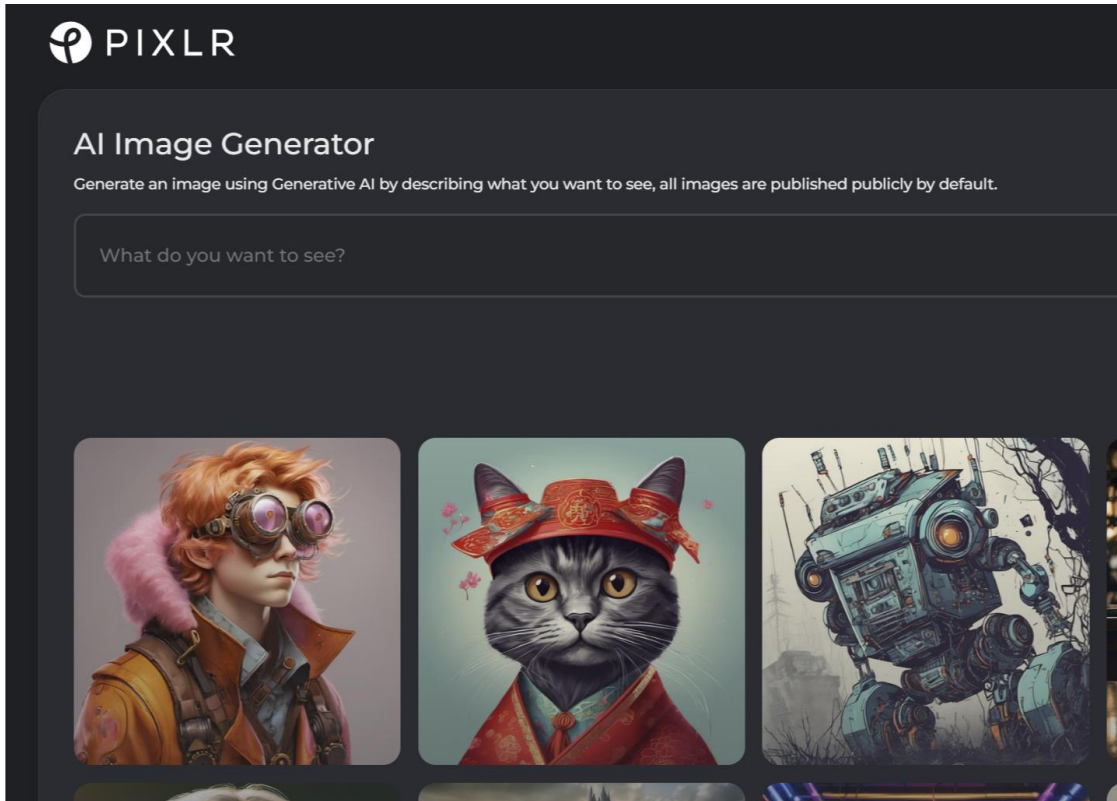
"Traditional" AI


- Performs specific tasks based on rules or learned models
- Makes decisions or predictions from existing data without generating new content
- Examples: image classification, speech recognition, recommendation systems
- Used in automation, data analysis, or assisted decision-making

Generative AI


- Creates new and original content (text, images, music, etc.)
- Based on models that learn to generate data similar to the examples they were trained on
- Examples: ChatGPT for text generation, DALL-E for image creation
- Used in artistic creation, code generation, or writing assistance

GenAI



 **Vous**

Could you please give me a one-paragraph summary of the Chapter 2 of the AI Index Report ?

 **Copilot**

✓ Génération de vos réponses...

Chapter 2 of the AI Index Report 2024 focuses on trends in AI research and development. It begins by examining trends in AI publications and patents, then moves on to notable AI systems and foundation models. The chapter also analyzes AI conference attendance and open-source AI software projects¹. This comprehensive overview highlights the rapid advancements and growing influence of AI across various domains.

Is there a specific aspect of AI research you're particularly interested in?

En savoir plus 1 aiindex.stanford.edu 2 oecd.ai



1 sur 30 réponses

Le contenu généré par l'intelligence artificielle peut être inexact

Tell me more about AI patents.

What are some notable AI systems?

How has the pandemic affected AI conferences?



Posez-moi une question...



NICE CAPACITIES, SOME FUNNY LIMITATIONS

"Watercolor of a monkey sitting on a branch, looking at its phone, while a plane crashes in the background."



BUT ALSO SERIOUS DANGERS

Economic – Societal – Political - Safety

- The exact nature of the risks is under-defined (realistic or not, probable or not)
- The impact of intentional and unintentional misuse need to be controlled (impact of deepfakes, manipulation of information, hallucinations of the models...)
- AI models and systems are easily accessible for the general public. Establishing efficient safeguards (technical and regulatory) is compulsory.
- Media/press have a strong influence on public opinion, and may also affect political decisions.

Clarity and reliability on the risks and performance of GenAI are strongly required

GenAI AND METROLOGY

- GenAI for metrology
- Metrology of GenAI

GenAI USED FOR METROLOGY

- Generation of synthetic datasets
(based on real measurement data, to test or calibrate tools)
- Generative models for instrument calibration
(simulate measurement errors or extreme conditions)
- Predictive analysis and modeling
(generate behavioral models for sensor degradation)
- Automation of metrological reports
(based on collected raw data)
- ...

The data is now presented, and we can export it into Excel if we want, or we can ask ChatGPT to graph the data.

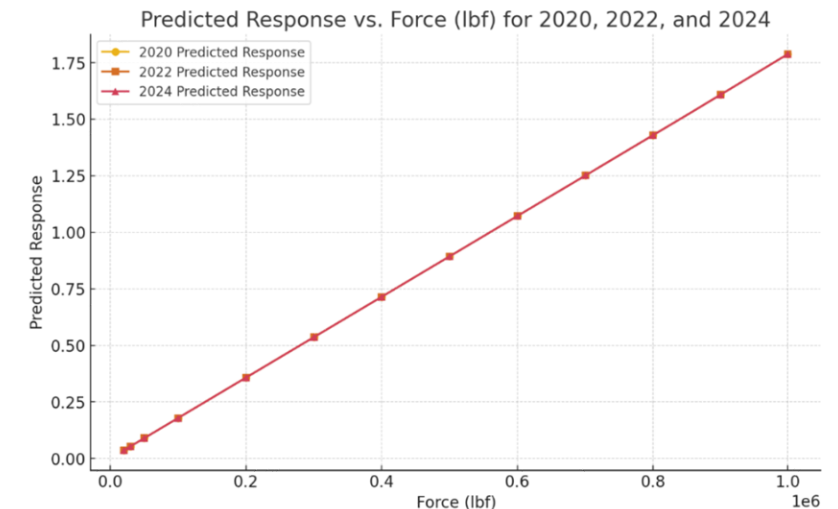


Figure 4 A Graph of the Data Plots

Though most of this is simple and can be a time saver when exporting from a PDF into Excel or another document,

What is very cool is the ability to predict future results and run a more comprehensive statistical analysis, which leads us to what I consider very useful Metrology AI.

<https://mhforce.com/metrology-ai-a-brief-overview-using-chatgpt/>

METROLOGY OF GenAI



METROLOGICAL PRINCIPLES

- Units of measurement
- Calibration
- Traceability
- Measurement uncertainty
- Accuracy, precision
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
 - Which units? Which performance criteria?
 - Metrics commonly accepted by the community (ex. <https://oecd.ai/en/catalogue/metrics>), but not "units of measurement"
- Calibration
- Traceability
- Measurement uncertainty
- Accuracy, precision
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- **Calibration**
 - Formal proof versus testing?
 - How to calibrate a software test bench?
- Traceability
- Measurement uncertainty
- Accuracy, precision
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- Calibration
- **Traceability**
 - What reference methods?
 - System / set of subsystems, diversity of applications, usage contexts, etc.
- Measurement uncertainty
- Accuracy, precision
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- Calibration
- Traceability
- **Measurement uncertainty**
 - Performance influencing factors? AI operating domain?
- Accuracy, precision
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- Calibration
- Traceability
- Measurement uncertainty
- **Accuracy, precision**
 - Reference values?
- Adaptation to technological advancements
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- Calibration
- Traceability
- Measurement uncertainty
- Accuracy, precision
- **Adaptation to technological advancements**
 - Lack of perspective – relying on existing best practices outside of AI
 - Methods and reference values that are sufficiently generalizable
- Conformity assessment

METROLOGICAL PRINCIPLES – APPLICABILITY TO AI

- Units of measurement
- Calibration
- Traceability
- Measurement uncertainty
- Accuracy, precision
- Adaptation to technological advancements
- **Conformity assessment**
 - Emerging, unfixed framework
 - Missing reference values and methods

METROLOGICAL CHALLENGES FOR GenAI

- **Performance evaluation**
(standardized measurement methods, performance criteria)
- **Interpretability and explainability**
(metrological standards, indicators for the comprehensibility of decisions made by AI systems)
- **Bias and ethics**
(identifying and quantifying biases in AI models to ensure fair and responsible practices)
- **Robustness and security**
(robustness of AI models against adversarial attacks, protection against vulnerabilities and cyber threats)
- **Data and data quality**
(quality of data used in AI model training, ensuring provenance, reliability, and diversity of data)
- **Interoperability**
(interoperability between different AI systems, ensuring consistency and compatibility)
- **Scalability and economy**
(measures to evaluate the performance of AI models at scale, economic efficiency in AI deployment and use)
- **Regulatory compliance**
(adherence to current regulations, metrological compliance indicators for audits and certifications)

METROLOGICAL CHALLENGES FOR GenAI

Metrology for GenAI:

- Necessary to ensure reliability, transparency, and trust
- Many research questions, but immediate economic and regulatory needs
- Strong international initiatives to tackle these issues
(OECD, G7, GPAI Global Partnership on AI, AISI AI Safety Institutes, etc.)

10-11 Feb. 2025
AI Action Summit, Paris
<https://www.elysee.fr/en/ai-action-summit>



**AI ACTION
SUMMIT**

Enhancing control of Generative AI through metrology

23rd meeting of NMI Directors, October 17th 2024

THANK YOU FOR YOUR ATTENTION

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