TURING

Trustworthy Unified Robust Intelligent Generative Systems

A pioneering European project that advances trustworthy and robust AI to model complex physical systems. It bridges artificial intelligence, physics, and engineering to create foundation models capable of simulating real-world dynamics across domains such as nuclear energy, particle physics, and meteorology. Through international collaboration and compliance with EU AI regulations, it promotes safe and impactful AI innovation.

SCIENTIFIC APPROACH

TURING combines data-driven and physics-informed modelling to pre-train generative, multimodal foundation models that integrate physical laws with experimental data. These models generalize across multiple domains and once fine-tuned, deliver high accuracy, robustness, and interpretability for scientific and engineering applications.

PROJECT OBJECTIVES

01
Leverage numerical methods and AI to create physically consistent models of complex phenomena.

02
Advance generalization capabilities while maintaining robustness and reliability.

03
Develop a Unified Physics-Aware Generative AI Framework.

04
Validate and refine TURING models through high-impact experiments.

05
Maximize impact and alignment with EU innovation and regulatory frameworks.

FIVE SCIENTIFIC USE CASES

UC 01
Foundation models for particle physics detector simulation

AI-driven particle detection and simulation combining deep learning, HPC, and experimental physics.

UC 02
Nuclear reactor operational safety and efficiency using generative AI

AI-based optimization of reactor design, operation, and safety through advanced modeling and simulation.

UC 03
AI-Enhanced Criticality Safety Analysis for Nuclear Systems

AI methods to improve safety limits estimation and reduce computational bias in nuclear criticality analysis calculations.

UC 04
Debris Bed Formation during Severe Accidents

Accelerated and accurate debris bed cooling simulations for enhanced nuclear accident analysis.

UC 05 **Robust data-driven Models for Weather Forecasting**

Developing robust and transparent AI models for accurate, resource-efficient weather predictions.

METHODOLOGY

Whitebox Models/Data → Pretrained Models → TURING Models → TURING Framework

WP2 DOMAIN ANALYSIS
- Data analysis
- Domain representations extraction
- Baseline AI model selection

WP3 PRETRAINING
- Physics-informed AI
- Interpretability in lower-dimensional representations
- Model-agnostic Meta learning
- Adversarial robust model training
- Federal & Distributed Transformers

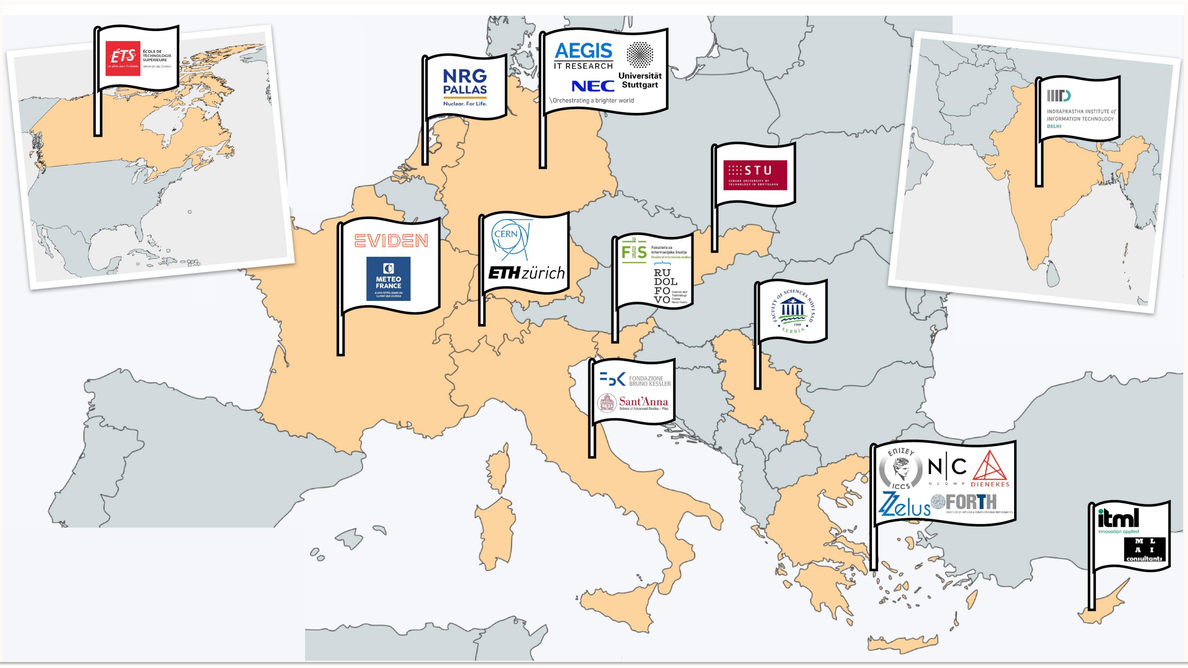
WP4 FINETUNING
- Low-shot learning
- Uncertainty quantification and trade-offs
- Efficient inference

WP5 USER-CENTRIC SERVICES
- Computing Infrastructure
- Pre-trained AI foundation models & user query services
- TURING models training & inference pipelines
- Integration & deployment pipelines

WP6 APPLICATIONS / EVALUATION
- Nuclear domain physics models and simulations
- Particle physics models and simulations
- Weather physics models and simulations

THE TURING CONSORTIUM

23 consortium partners across 12 countries



CONNECT WITH TURING

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