2022 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

Virtual Sully: Autopilot with Multi-Level Adaptation for Handling Large Uncertainties

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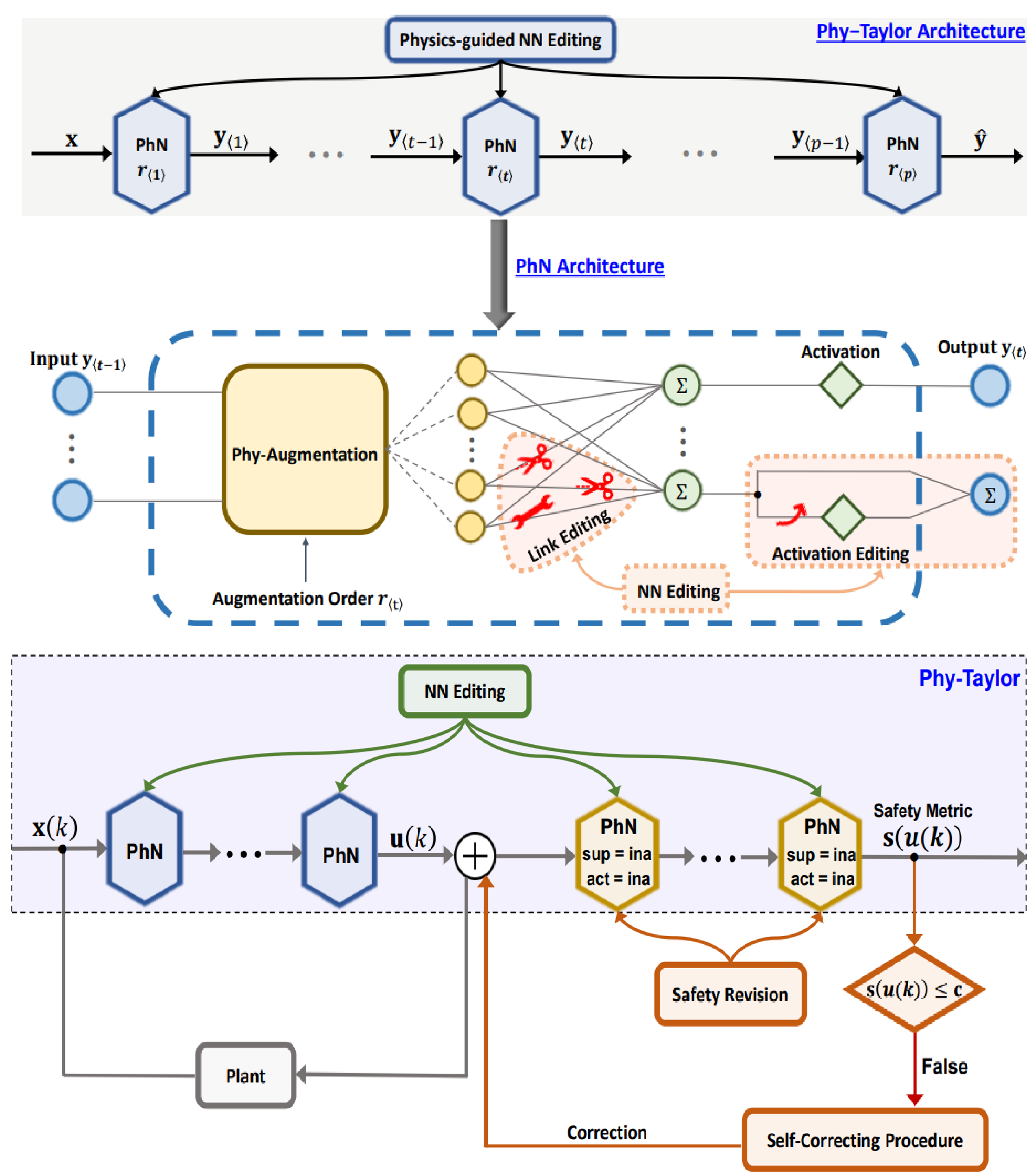
Goal: Pilotless autonomy, capable of identifying the failure/fault, estimating the remaining control authority, assessing environment and planning a new feasible mission, doing the path planning and executing it safely within the compromised flight envelope.

Key Result: Using deep neural networks (DNNs) to learn human experts (e.g., Captain Sully) for safe decision making.

Challenge: Purely DNNs applied to physical engineering systems can infer relations that violate physics laws, thus leading to unexpected consequences.



Solution: Physics-model-based DNN framework, called Phy-Taylor.

- It introduces a new architectural physics-compatible neural network,
- It features a novel (strict) prior physics compliance mechanism: physics-guided neural network editing.

Impacts:

- Phy-Taylor prompts reliable DNNs for safety- and time-critical DNNs.
- Safety capabilities of Virtual Sully will enable a new generation of UAVs with much greater autonomy.
- The experimental platforms will be available for undergraduate and graduate courses.