# Technical Test – Trajectory Learning and Optimized Tracking in Simulated 2D Space

**Challenge Overview:**

The goal is to design and implement, using PyTorch, a Physics informed neural network (or PiNN [1] ) capable of learning the trajectory of a badminton shuttlecock based on simulated data generated from the physical equations governing its motion in a 2D Euclidean space. This model should accurately predict the shuttlecock’s position (x(t),y(t)) at any given time, even when handling missing data or potential noise.

**Detailed Steps:**

## Understanding Trajectory Learning in 2D Space and Spatio-Temporal Tracking:

* + Trajectory Learning in 2D [2]: Demonstrate an understanding of neural networks designed to track objects based on physical trajectories in 2D space. Emphasize the approach of using pre-defined motion equations to create simulated shuttlecock data [3].

**Expected outcomes**: presentation (slides)

## Design and Implementation of the Deep Architecture:

* **Task1**: Implement a neural network architecture that learns from the 2D simulated data, using the trajectory equations to guide position predictions over time. Evaluate the model’s performance on metrics like detection accuracy, false positives (FP), false negatives (FN), and inference latency.

**Expected outcomes:** Architecture explanation and a github repo that contains the work or a .zip

## Documentation and Presentation (**Optional**):

* + Code and Explanation: Document code with detailed design rationales, especially on how physical equations and noise reduction are integrated.
  + Results Analysis: Analyze results with comparisons across configurations, emphasizing the model’s handling of noise.
  + Visualization: Include trajectory plots or other visual aids to clearly represent how the model tracks the shuttlecock over time in the simulated 2D space.

**Evaluation Criteria:**

* Understanding of Trajectory Learning and Spatio-Temporal Tracking: Assess the candidate’s grasp of these concepts and their explanatory clarity.
* Implementation Quality: Evaluate the effectiveness and robustness of the PyTorch implementation in simulated scenarios.
* Analysis and Interpretation: Judge the depth of analysis in handling noisy and ambiguous data.
* Presentation: Assess the clarity and professionalism of the documentation, including the use of visualizations to communicate results.

**P.S.**

* Upload the outcomes to your GitHub, regardless of the results—this will serve as a valuable

addition to your porbolio.

* Be careful, the working method and organization (commits, design, …) will be considered.

**References:**

[1] [Réseaux de neurones informés par la physique (PINN) - MATLAB & Simulink](https://fr.mathworks.com/discovery/physics-informed-neural-networks.html)

[2] [tbensky/PiNN\_Projectile: Modelling the physics of projectile motion with drag using a neural network](https://github.com/tbensky/PiNN_Projectile)

[3] [A Study of Shuttlecock’s Trajectory in Badminton - PMC](https://pmc.ncbi.nlm.nih.gov/articles/PMC3761540/)

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