



Laser Seam Tracking System for Automated Welding

Developing an industrial-grade simulation framework for Laser Seam Tracking (LST) in robotic welding using ABB RobotStudio and the RobotStudio SDK.

TEAM MEMBERS SYNAPSE

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Background and Motivation

Robotic welding relies on pre-programmed paths that are easily affected by fixture errors, thermal distortion, and manufacturing variations, causing weld seam deviations. Although commercial Laser Seam Tracking (LST) systems can correct these deviations, validating them on physical robots is costly and time-consuming. This project develops an ABB RobotStudio Add-In that enables simulation and validation of LST workflows in a digital twin environment before deployment.

Technologies



Objective

Developing a RobotStudio-based LST simulation framework that enables **virtual seam detection, trajectory correction, and welding path validation** before deployment on ABB industrial robots.

Methodology

1. Nominal Weld Path Generation

Import virtual or recorded seam data, perform coordinate transformation, and remove noise through filtering and smoothing.

2. Seam Deviation Simulation

Fit the weld seam using geometric algorithms (Line, Polynomial, B-Spline, NURBS, or user-defined methods) to generate a continuous seam model.

3. Virtual Laser Scanning

Compare the detected seam with the nominal welding path and compute correction offsets to generate updated robot trajectories.

4. Seam Detection & Path Correction

Visualize the corrected path in RobotStudio, execute the simulation, and evaluate tracking performance using quantitative metrics.

5. Visualization & Performance Evaluation

Export corrected robot targets, RAPID modules, validation reports, and performance metrics for ABB robotic welding applications.

UI LAYER

(RobotStudio SDK / C# .NET)

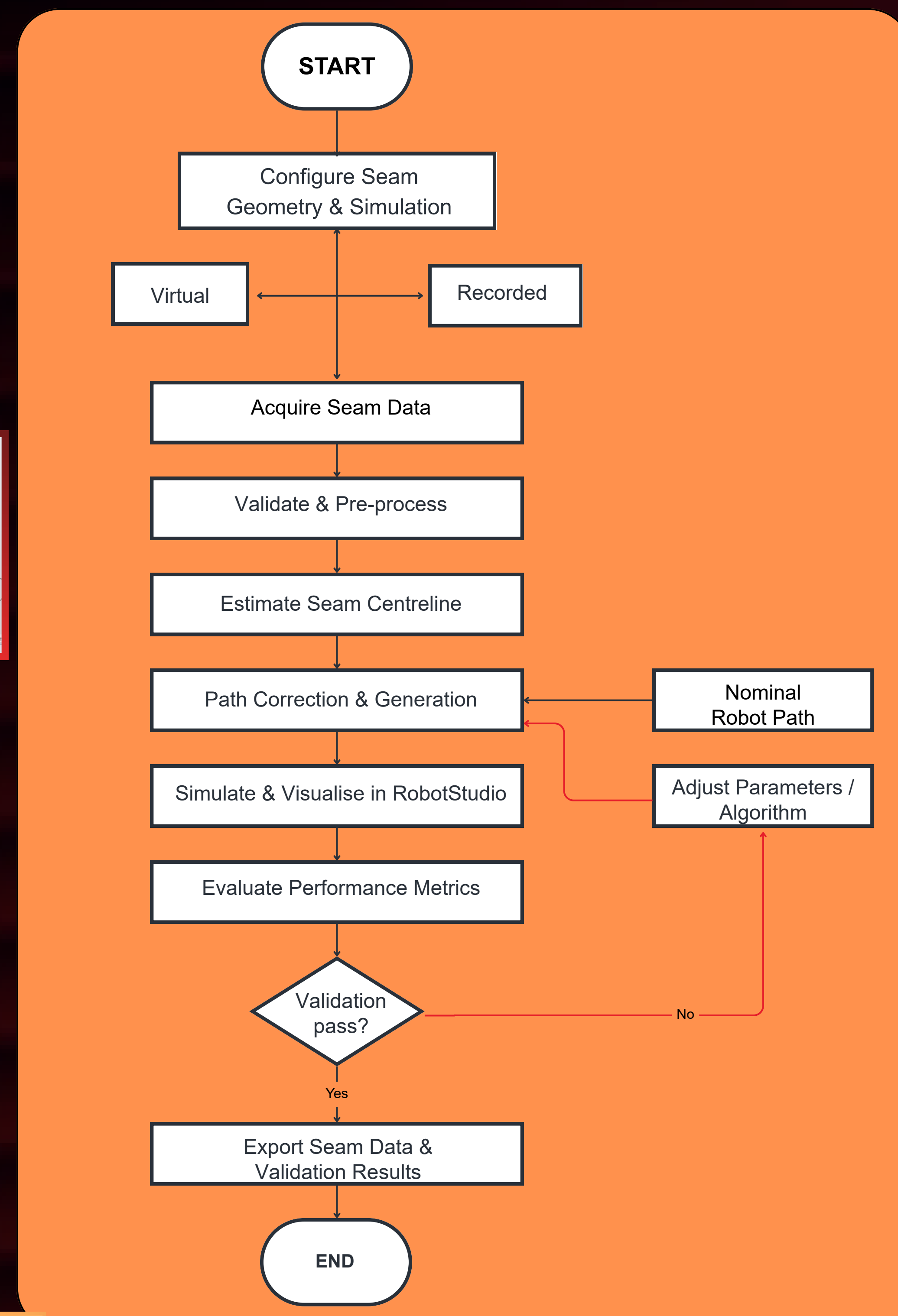
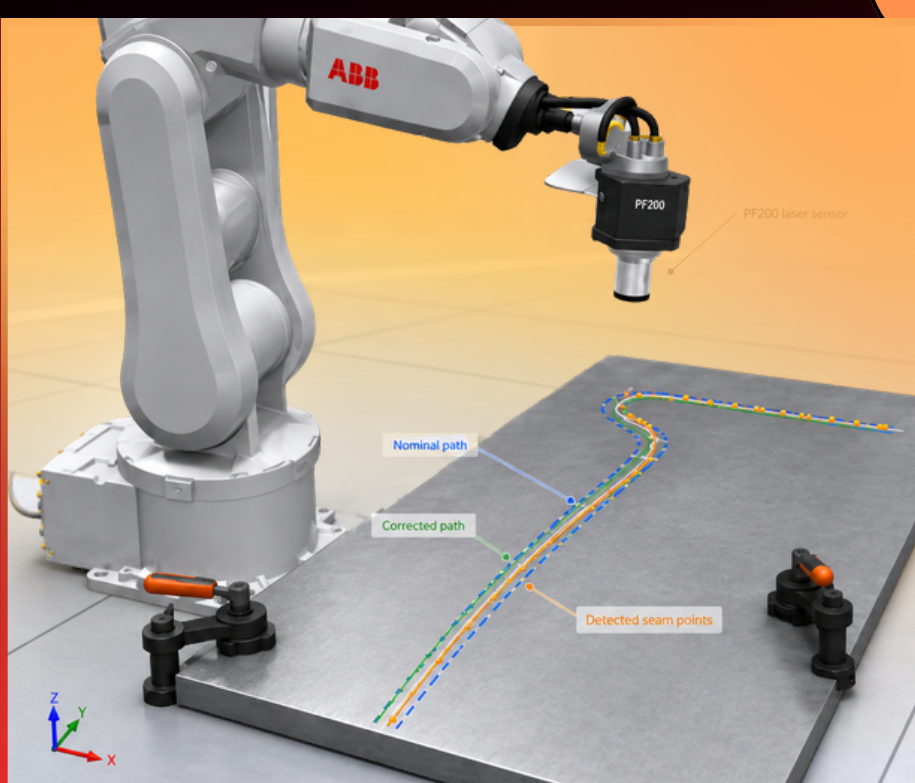
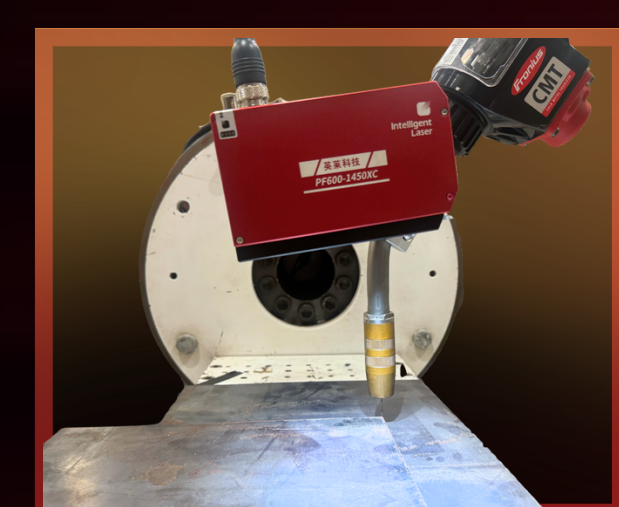
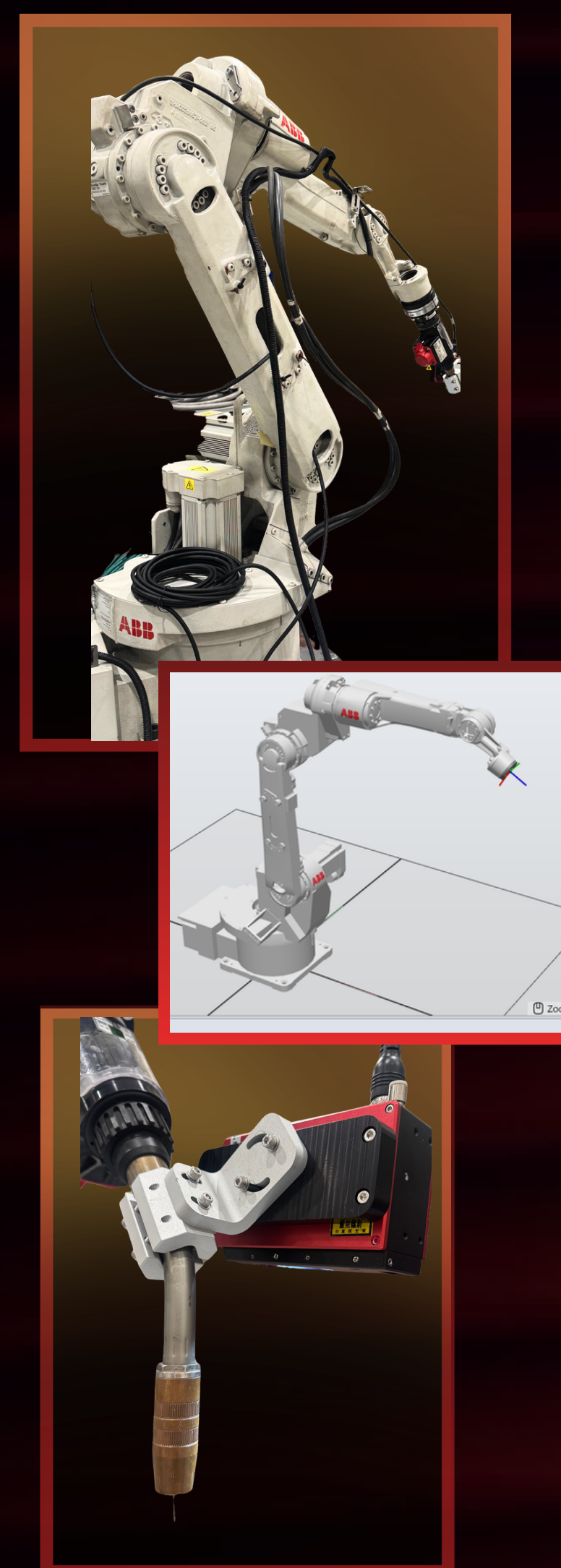
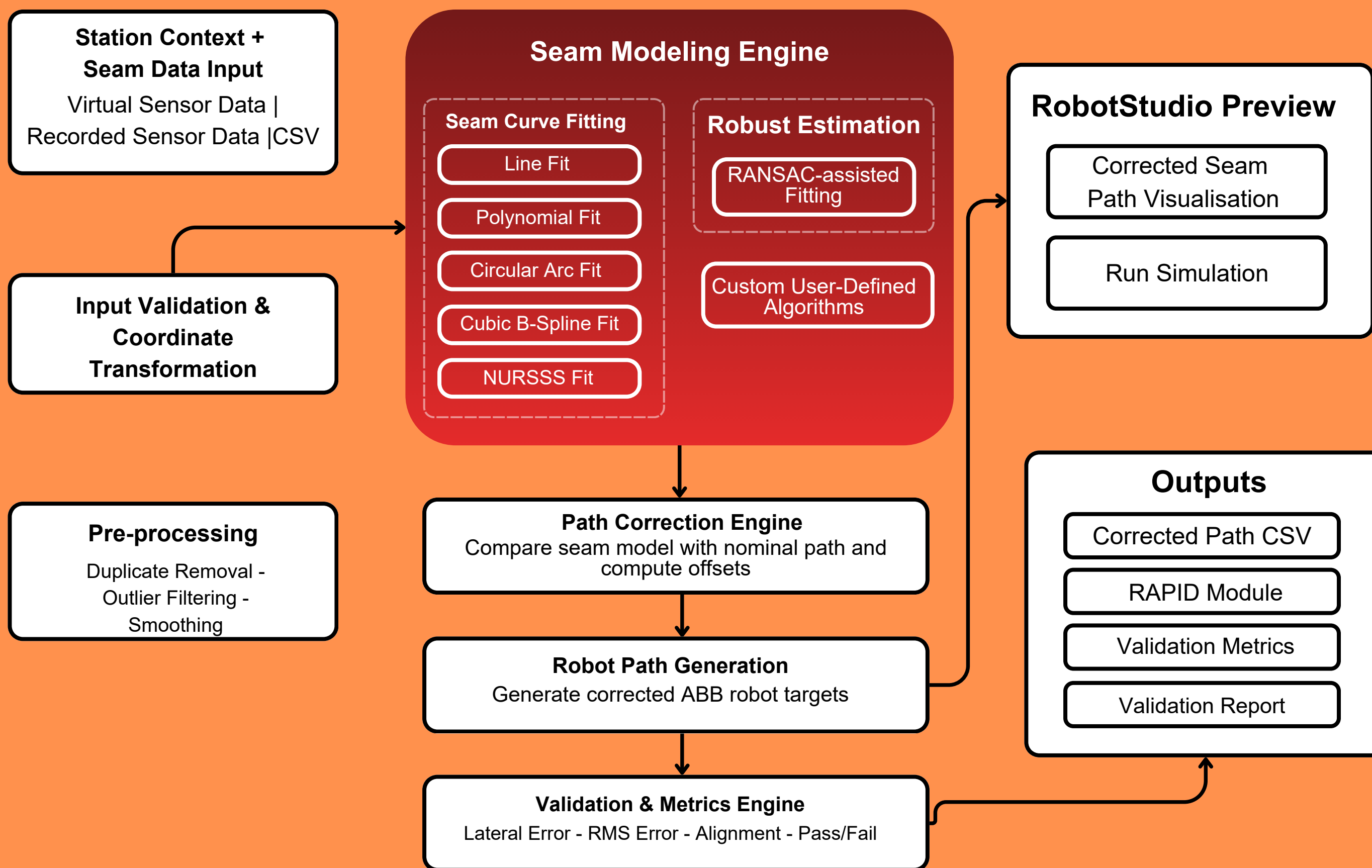
Setup

Preview

Validation

Export

Processing / Core Layer



Assessment Category	Evaluation Metric	ABB Target	Achived Result
Seam Detection	Mean Lateral Error	$\leq \pm 0.5$ mm	≤ 0.5 mm achieved in tested virtual cases
Path Correction Accuracy	Alignment with true seam	$\leq 90-95\%$	46.02% average alignment 69.23% average improvement
Robustness	Maximum seam offset handled	$\pm 2-3$ mm	± 2.0 mm validated Butt, Fillet, Lap; 75 scenarios
Simulation Reliability	Successful simulation runs without errors	$\geq 95\%$	75/75 scenarios completed without errors (100%)

Future Work

- Validation on ABB industrial robotic welding cells
- Add support for other sensor models