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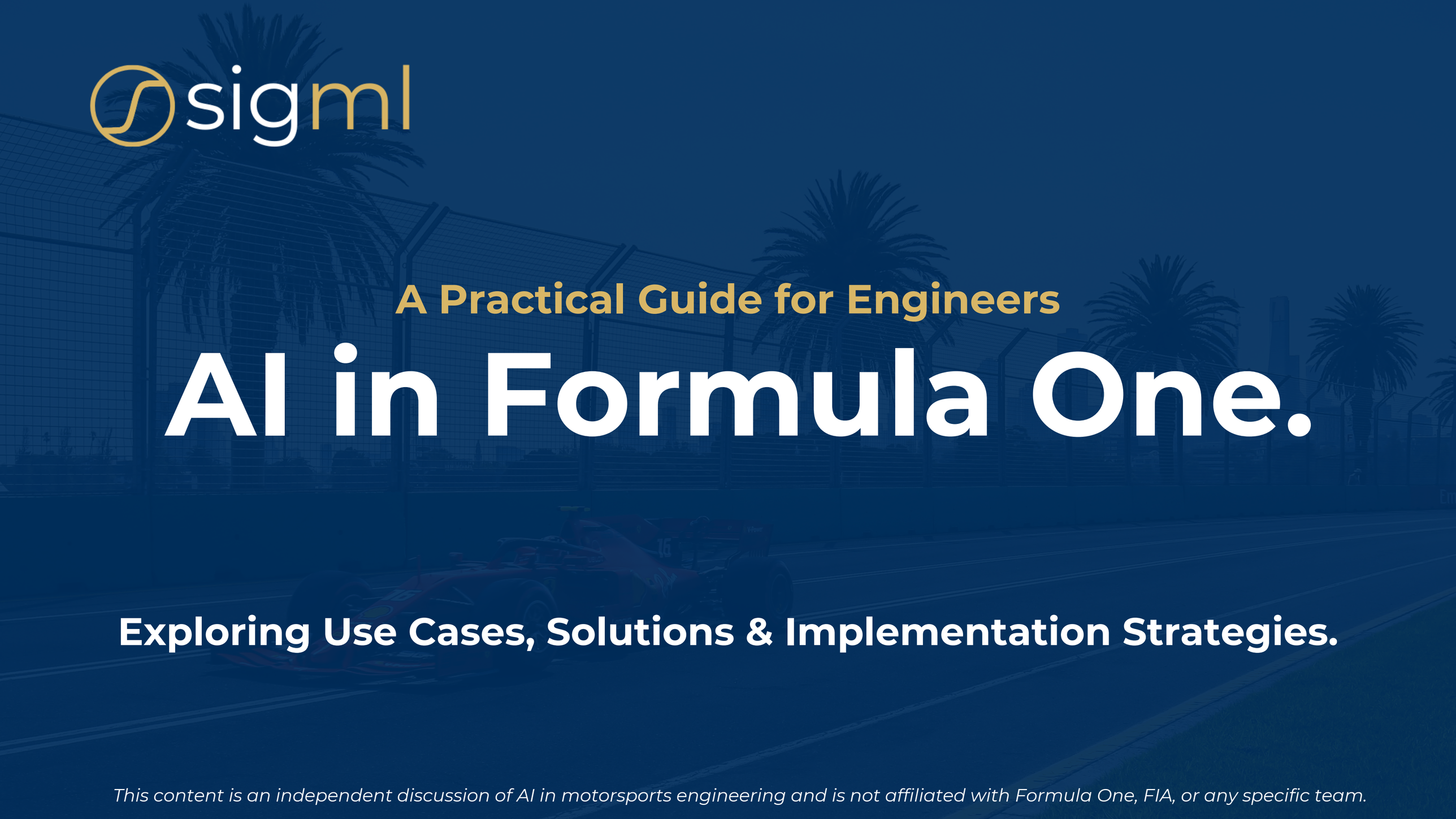
A Practical Guide for Engineers

AI in Formula One.

Exploring Use Cases, Solutions & Implementation Strategies.



This content is an independent discussion of AI in motorsports engineering and is not affiliated with Formula One, FIA, or any specific team.

Introduction

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Formula One: the pinnacle of speed, strategy, and precision.

In a sport where every millisecond counts, teams push the limits of performance with cutting-edge technology. While drivers and machinery operate at the edge, AI is giving engineers the tools to process complex data faster, refine strategies in real time, and extract deeper performance insights.
Now, a new race is unfolding—the race to smarter decisions, greater efficiency, and dynamic strategies.

Teams that define their AI strategy, construct the right models, and integrate intelligent decision-support tools will have the edge in Formula One's data-driven future. The race is on.

Challenge

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In today’s fast-paced, data-driven environment, racing teams need to process massive amounts of information while making critical decisions under pressure.

1	**LIMITED TIME**	Decisions need to be fast, precise, and backed by data.
2	**COMPLEX TRADE-OFFS**	Performance, reliability, and strategy must be optimised simultaneously.
3	**DATA OVERLOAD**	Vast streams of telemetry, simulations, and race data need to be analysed
4	**TRADITIONAL MODELS**	Can be assumption-heavy, siloed, static and/or time-intensive to manage.

Solution

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Integrating AI with optimisation modelling enables teams to pre-analyse data, predict key events, and refine decision-making in real time.

1	**FASTER**	Reduces manual analysis time, enabling rapid, data-driven decisions.
2	**SMARTER**	Optimise trade-offs in performance, reliability, and efficiency.
3	**DATA-DRIVEN**	Transform vast telemetry and simulation data into actionable insights.
4	**CUSTOMISED**	Physics-informed, based on real-world data, customised to specific drivers and machines.

AI in Motorsports: Use Cases

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Enhancing modelling, simulation, and decision-making across key engineering domains:

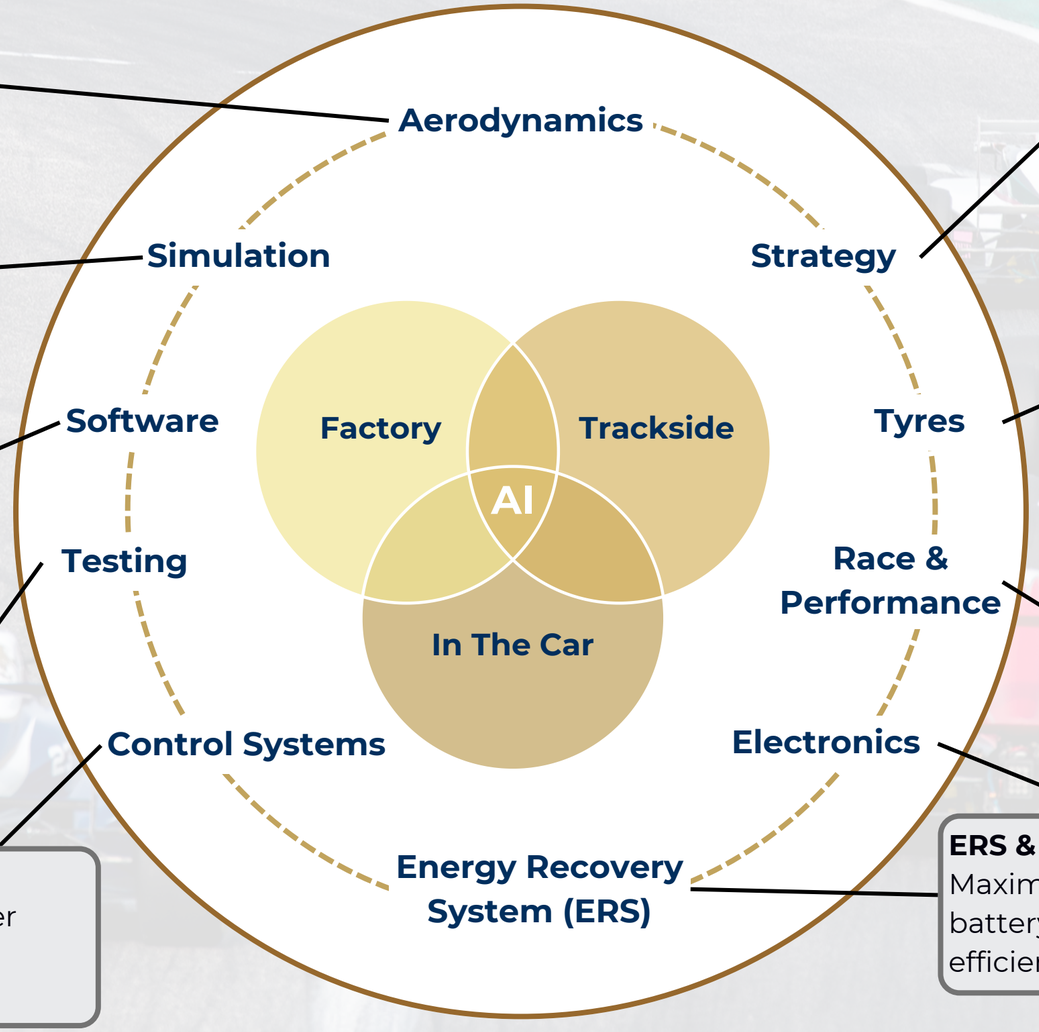
Aerodynamics
Improving CFD analysis, wind tunnel correlation, and airflow efficiency.

Simulation
Optimising test programs and refining validation methods.

Software & Data Analytics
Extracting deeper insights for in-house analytics and cloud platforms

Testing
Combining real and simulation data to validate components, improve hardware-in-the-loop models.

Control Systems
Improving car balance, traction, adaptive power deployment, and response to variable track conditions.



Strategy & Race Execution
Enhancing predictive modelling for in-race decisions, pit stop timing, and competitor analysis.

Tyre Performance
Forecasting degradation trends and optimising stint strategies.

Race & Performance
Refining racing lines, identifying optimal overtaking zones, and providing driver guidance based on AI-driven insights.

ERS & Electronics
Maximising hybrid power deployment, managing battery charge cycles, and optimising energy efficiency.

Let’s drilldown further into specific use cases for each engineering discipline.

AI for Strategy Engineers

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Optimising Race Execution & Scenario Planning

Why It Matters

Formula One race strategy depends on hundreds of interconnected variables, from tyre degradation to safety cars and competitor tactics. AI enables engineers to process vast amounts of real-time data to refine race strategy dynamically.

How AI-based Engineering Technology Can Help

✓ Predicts the optimal pit stop timing based on evolving race conditions.

✓ Simulates multiple strategy outcomes to determine the best approach.

✓ Calculates overtaking probability by assessing traffic, ERS deployment, and competitor behaviour.

Project Opportunities

AI-driven pit stop models

Predict the impact of different pit stop strategies on race outcomes, accounting for dynamic environment (track evolution), competitor behaviour (e.g. Undercuts), and events (Safety Car, Virtual Safety Car).

Competitor race simulations

Model likely moves from competitors based on historical patterns, to guide potential deviations from lap time to position optimisation.

Overtaking strategy modelling

Predict the best opportunities for overtaking based on power deployment and track position.

AI for Race / Performance Engineers

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Enhancing Real-Time Decisions

Why It Matters

Race and trackside engineers process vast amounts of live telemetry, making split-second adjustments to maximise performance. AI provides decision-support tools that help engineers interpret data faster.

How AI-based Engineering Technology Can Help

- ✓ Monitors real-time telemetry and delivers racing line optimisation opportunities.
- ✓ Provides predictive alerts on tyre degradation, fuel usage, and ERS deployment.
- ✓ Refines setup adjustments based on track evolution data.

Project Opportunities

Racing Line Optimisation

Flag potential opportunities to optimise individual driver racing line and braking zone characteristics.

Live energy management optimisation

AI assists in adjusting deployment strategy during the race.

Competitor performance forecasting

Model how rival teams are likely to react during the race.

AI for ERS & Electronics Engineers

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Maximising Hybrid Power Efficiency & Reliability

Why It Matters

Energy Recovery Systems (ERS) plays a critical role in on-track power and performance, but energy deployment must be carefully managed to avoid overuse and ensure the right power is available at key moments. AI helps teams optimise energy deployment strategies while maintaining system reliability.

How AI-based Engineering Technology Can Help

- ✓ Optimises ERS energy deployment based on live telemetry.
- ✓ Predicts State of Charge (SoC) trends to avoid over-depleting energy reserves.
- ✓ Identifies potential faults in hybrid power components before failures occur.

Project Opportunities

AI-driven ERS mapping

Determine the best deployment strategy for different track sections.

Thermal load optimisation

Predict overheating risks and suggests cooling strategies.

ERS reliability modelling

Identify early warning signs of ERS component wear.

AI for Tyre Engineers

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Predicting Wear, Stint Optimisation & Crossover Points

Why It Matters

Tyre performance is one of the biggest factors in race strategy and car performance. AI enables teams to predict tyre degradation, optimise stint lengths, and adjust strategies based on real-time conditions.

How AI-based Engineering Technology Can Help

- ✓ Predicts tyre degradation trends based on track conditions and driver behaviour.
- ✓ Determines optimal tyre compound selection for each race.
- ✓ Calculates crossover points for slicks vs. intermediates in evolving, wet conditions.

Project Opportunities

Tyre life forecasting

AI models predict when tyres will begin to fall off the curve.

Weather-dependent strategy modelling

AI helps teams decide the right moment to switch to different compounds.

Tyre warm-up & cooling optimisation

Predicts how tyres will behave under different track temperatures.

AI for Aerodynamicists

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Optimising CFD, Wind Tunnel & Track Correlation

Why It Matters

Aerodynamics is one of the most data-intensive areas of Formula One development. Engineers may run thousands of CFD simulations and wind tunnel tests, but the challenge lies in refining models, correlating data, and optimising test efficiency.

How AI-based Engineering Technology Can Help

✓ Speeds up aerodynamic simulations by optimising input parameters for CFD and wind tunnel testing.

✓ Improves correlation between CFD, wind tunnel, and track performance data to enhance accuracy.

✓ Identifies airflow trends and inefficiencies that may not be immediately apparent in raw data.

Project Opportunities

Using AI to refine CFD parameter selection

Instead of running every possible simulation, AI identifies which conditions are most valuable for testing, reducing unnecessary computational load.

Applying AI for wind tunnel correlation

AI analyses historical data to detect deviations between wind tunnel results and track performance, helping engineers improve correlation models.

AI-assisted aerodynamic efficiency models

AI assists in predicting drag/downforce trade-offs for different track layouts, helping teams optimise aero configurations faster.

AI for Simulation Engineers

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Enhancing Testing, Validation & Real-Time Adaptability

Why It Matters

Formula One teams rely on extensive Driver-in-the-Loop (DIL), wind tunnel, and CFD simulations to refine race strategy, car setup, and performance. The challenge is knowing which simulations will provide the most useful insights and ensuring they align with real-world performance.

How AI-based Engineering Technology Can Help

✓ Prioritises the most valuable simulation runs based on expected learning and performance impact.

✓ Refines parameter selection to ensure tests capture a wider range of meaningful data.

✓ Improves correlation between simulations and real-world performance, reducing discrepancies.

✓ Adapts scenario-based simulations in real time, allowing engineers to refine models dynamically.

Project Opportunities

AI-driven simulation prioritisation

Predict which test conditions will yield the most valuable performance insights based on setup objectives and individual driver racing characteristics.

Optimising real-time simulation feedback

AI helps adapt scenario-based models during races to refine strategy.

Enhancing DIL correlation with AI

AI aligns DIL test results with real-world track data, improving accuracy.

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At SIG Machine Learning, we help identify, test and implement AI-based Engineering Technologies.

Solution

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nexgineer™
AI platform for engineering teams.

AI-based engineering technologies to streamline race strategy, enhance vehicle reliability, optimise performance and more.

Projects

AI Implementation Framework with Nexgineer™

Delivering Projects with Nexgineer™

1 - Connect — Integrate data from sensors, simulations, and operations.

2 - Model — Use AI to analyse multivariate data and predict key events.

3 - Simulate — Test strategies under real-world constraints.

4 - Optimise — Act on AI-driven recommendations to optimise performance.

From data to decisions—structured AI implementation for engineering teams.

Next Steps

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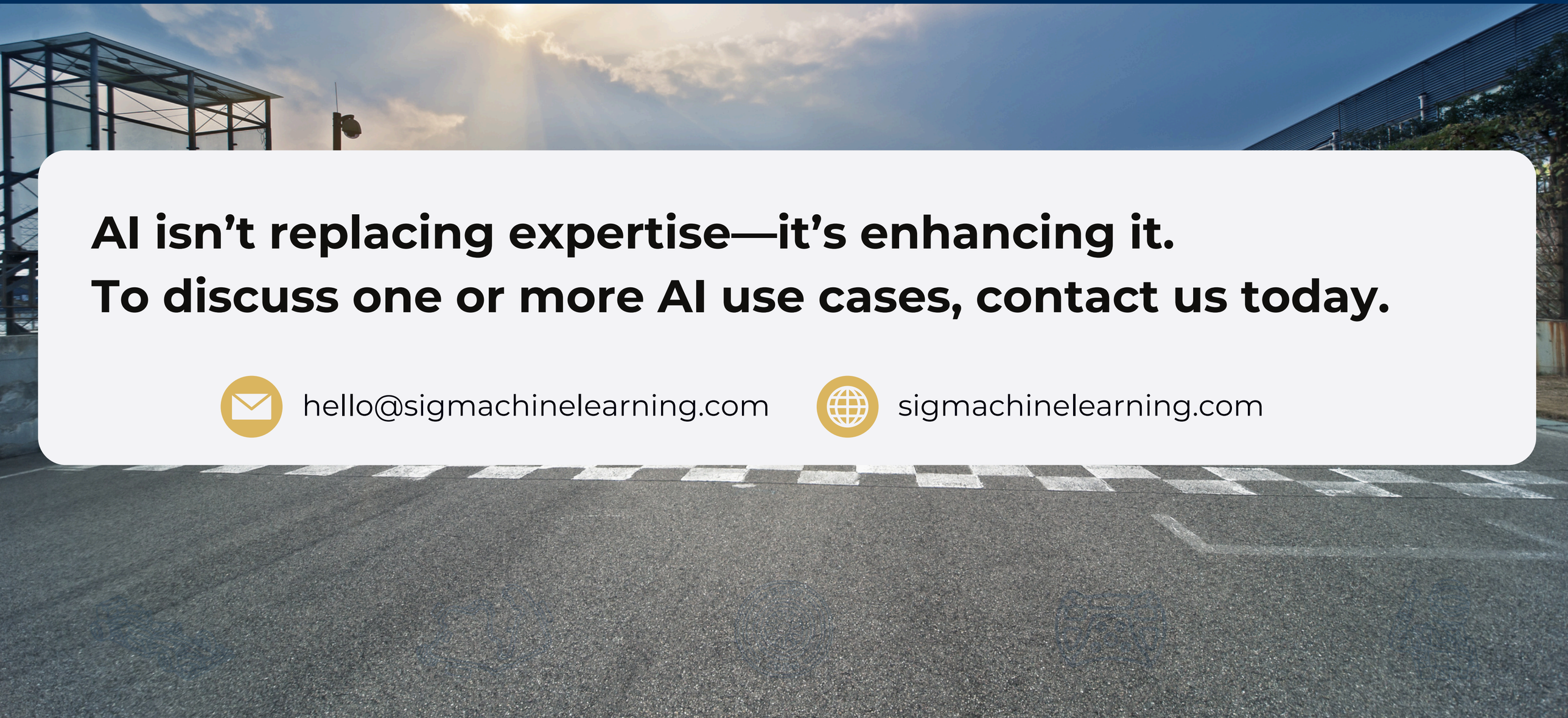

AI isn’t replacing expertise—it’s enhancing it.
To discuss one or more AI use cases, contact us today.

hello@sigmachinelearning.com

sigmachinelearning.com