



4IR Technologies:
AI, Autonomous systems

Emirate:
Abu Dhabi

Maturity:
■■■■□
Operational Deployment

Type:
Public-Private

CREATIVE INDUSTRIES

095 Autonomous Racing League (A2RL)

ACTORS

ASPIRE
Technology Innovation Institute, Autonomous Robotics
Research Centre
Dallara
Yas Marina Circuit

SNAPSHOT

The Abu Dhabi Autonomous Racing League (A2RL) is a motorsport competition in which international teams race full-size cars controlled entirely by software. Each team receives the same Dallara Super Formula vehicle but develops the AI controlling its racing line, braking, acceleration, overtaking, and response to rival cars.¹

ASPIRE, the grand challenges arm of Abu Dhabi's Advanced Technology Research Council (ATRC), launched A2RL at Yas Marina Circuit in April 2024, with eight teams, four of which raced together in the Grand Final. By November 2025, A2RL had expanded to 11 teams competing for a share of the season's USD 2.25 million prize pool. Six teams advanced to the 20-lap Grand Final. Germany's Technical University of Munich retained the title, followed by the UAE's TII Racing and Italy's PoliMOVE.²

WHY IT MATTERS

A2RL changes what makes the difference in a motor race. Every team uses the same car and there is no human driver, so the main contest is between the software systems developed by the teams. One car may brake later, take a faster line, or respond more effectively to an opponent because its software has interpreted the situation differently.³

The 4IR element is the full autonomous stack running at racing speed: sensor fusion from cameras, radar, and lidar, real-time perception and localisation, and decision-making software that plans a racing line and executes overtakes without human input. A2RL is therefore a competition between AI systems rather than a demonstration of a single autonomous vehicle. Teams compete under the same rules and on the same circuit, translating differences in code into outcomes that spectators can readily judge: qualifying times, overtakes, mistakes, and the final classification.

The racing also anchors a broader live event designed to make autonomous technology accessible to the public. A2RL's inaugural edition featured a Human-versus-AI contest, digital team avatars, virtual reality, racing simulators, an AI museum, live performances, and a drone display. More than 10,000 spectators attended that first edition at Yas Marina Circuit, while over 600,000 watched online during the first 12 hours. Organisers later reported more than one million streaming views across the debut season.^{4,5}

HOW THE TECHNOLOGY WORKS

The cars are autonomous versions of Dallara's SF23, the single-seater used in Japan's Super Formula championship. Seven cameras provide a continuous view around the vehicle. Four radar sensors and three LiDAR sensors measure the circuit boundaries and surrounding cars, while satellite positioning and inertial sensors track the car's own movement.⁶

The software performs three main functions. Perception identifies the track and other vehicles. Planning selects a racing line and decides how to respond. Control converts those decisions into steering, throttle, braking, and gear commands through the drive-by-wire systems. Each team receives the same vehicle and basic autonomous functions, then develops its own perception, planning, and control software.⁷

Trackside officials can activate an emergency stop but cannot steer the car. The upgraded EAV-25 also introduced active hydraulic emergency braking, a secondary inertial sensor for redundancy, and battery-management protections.⁸

Teams develop their software further through A2RL's SIM-Sprint competition. Digital races allow them to test overtaking, multi-car traffic, and unusual situations without damaging the physical vehicles. The simulations also help organisers refine rules for collisions, penalties, and protests.⁹ By July 2026, the 11 teams had completed more than 5,000 collective hours of simulated testing and racing.¹⁰

IMPACT AND RESULTS

A2RL demonstrated clear technical progress between its first two seasons. In 2024, the Grand Final had to be stopped after a spinning car blocked the field.¹¹ By 2025, six autonomous cars were competing simultaneously at speeds above 250 kilometres per hour. Italy's Unimore Racing team, representing the University of Modena and Reggio Emilia, overtook Germany's Technical University of Munich (TUM) team and maintained a lead of less than 1 second for much of the next 10 laps. TUM regained the lead after Unimore collided with a slower car during another overtaking attempt.¹²

Autonomous lap times also approached professional human performance. Unimore completed the Yas Marina North Circuit in 58.87 seconds, beating the 59.30-second professional-driver benchmark recorded during data collection.¹³ In the direct Human-versus-AI contest, former Formula One driver Daniil Kvyat remained faster, but his advantage fell from 10.38 seconds in 2024 to 1.58 seconds in 2025. This represents an approximately 85% reduction in 18 months.^{14,15}

During 6 weeks of track testing in 2025, the teams completed 1,640 laps and 5,400 kilometres, generating more than 300 terabytes of data.¹⁶ Separately, researchers released the open A2RL Vmax dataset using data contributed by all eight teams that competed in the inaugural 2024 season. It contains 305,531 LiDAR point clouds, 386,006 radar point clouds, and 28,791 annotated LiDAR frames from single-car and multi-car racing.¹⁷

For the 2025 final, more than 8,000 spectators filled Yas Marina's North Grandstand. A parallel programme involved over 140 students from all seven emirates, who programmed and raced scaled autonomous cars.¹⁸ Two seasons are complete, international participation continues, and racing performance has improved measurably.



WHAT'S NEXT

A2RL held its first race outside Abu Dhabi at Italy's Imola Circuit on 5 September 2026, the first multi-car autonomous race staged in Europe. Run over 12 laps as part of the ACI Racing Weekend, the race was won by the UAE team Kinetiz. Imola's elevation changes, narrow racing lines and limited run-off areas provided teams with a substantially different setting from Yas Marina Circuit. The series is expected to return to Abu Dhabi for its 2026 season finale.¹⁹

The simulation programme could also widen access to the competition. A2RL has proposed a progression from Sim Academy to Sim Pro and eventually to qualification for physical racing. If implemented, programmers could enter through virtual competition before gaining access to the more expensive full-scale cars. This could connect esports, engineering education, and autonomous motorsport within the same competitive structure.²⁰

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