Build Intelligent Robots Faster with Simulation
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Robots perform increasingly complex tasks in our houses, warehouses, and even hospitals. But to work effectively and safely in the real world, robots need sophisticated software. Such software requires robust, repetitive, and scaled testing and training to eliminate code errors and ensure safety.

Even so, testing robotics applications and training machine-learning models present their own set of challenges. Real-world testing is expensive, time-consuming, and difficult to scale. That's why computer simulation is an essential tool for developers to build and test intelligent robotics applications.

Benefits of simulation

- Reduce the risk and cost of testing in the real world with 3-dimensional virtual environments, or “simulation worlds”
- Run hundreds of varied tests simultaneously to accelerate testing and increase testing coverage
- Automate testing into a DevOps workflow to find and fix bugs earlier

Hurdles to using local-computer simulation

- Building 3D simulation worlds is expensive, time-consuming, and requires specialized skills
- Sizing, procuring, deploying, managing, troubleshooting, and scaling server infrastructure to run simulations is expensive
AWS RoboMaker provides a cloud-based simulation service that makes it faster and easier than ever to build and test robotics applications. AWS RoboMaker makes simulation affordable and accessible by providing the tools developers need to test and iterate code in virtual environments. That way, you can focus on your core mission: building better robots.

Benefits of RoboMaker Simulation

- **Cost-effectively run, scale, and automate simulation**
- **Improve testing without additional development resources**
- **Run hundreds more simulations per day than local-computer simulation**
- **Easily create user-defined, randomized 3D virtual environments with RoboMaker WorldForge**
- **No infrastructure to buy or manage**
4 Simulation Use Cases

AWS RoboMaker Simulation supports a variety of robotics development use cases, many of which would be extremely difficult or impossible without cloud-based simulation. Here are a few.

1. **Automated Regression Testing**

   **Challenges:** Bugs and compatibility issues are introduced when developers write code separately
   **Impact:**
   - Longer QA cycles
   - Costly production errors and support time

   Defects can be missed until late in development or even in production
   **Impact:** Costly to fix

2. **Multi-Robot Fleet Testing**

   **Challenge:** Testing robots individually in simulation environments doesn’t prepare them to operate effectively with other robots
   **Impact:** Robots can behave unexpectedly, poorly, and even dangerously when interacting in the real world

   **The RoboMaker Solution**
   - Test robotics applications automatically while they’re being developed
   - Automate regression testing within a continuous integration and continuous delivery (CI/CD) pipeline
   - Run batch simulations using API calls

   • Connect multiple concurrent simulations to your central fleet-management software for testing
4 Simulation Use Cases

For some complex tasks in unpredictable environments, such as autonomous navigation and object manipulation, developers can't simply program an effective function. Instead, they train a robot iteratively with a system of reward functions so that the robot's software learns how to react properly. This is known as reinforcement learning (RL).

**Challenge:** It's nearly impossible to train RL models adequately in real-world environments because of the large number of iterative training cycles needed for a model to learn quickly.

**Reinforcement Learning**

Organizations that use robots or integrate robotics hardware into solutions often need to customize their robot functionality for specific use cases. They do this by developing Android, iOS, or web applications that work with the robot's software.

**Sandbox Testing**

**Challenge:** It is costly or even impossible to provide every developer a physical robot to test external mobile and web applications.

**The RoboMaker Solution**

- Perform high volumes of iterative trials simultaneously in parameterized environments
- Test applications in sandbox simulated environments—with no simulation experience needed
Let's take a look at how a variety of organizations are using AWS RoboMaker Simulation to develop better intelligent-robotics applications while drastically reducing time-to-market.
iRobot, a leading producer of robot mops and vacuums, uses AWS RoboMaker Simulation as part of its automated development and testing processes to increase code quality and release velocity while improving test coverage. With AWS RoboMaker, iRobot achieved:

- **50x** more tests per day
- **60** automated tests on each code commit
- **>5,000** automated tests for each software release candidate
- **20%** reduction in bugs published to their production code
- **50%** reduction in manual testing

“Like having 20 more QA testers”

—Chris Kruger, iRobot Director of Software Engineering
Test a fleet of >35 robots

Build a realistic simulation environment

Run simulations on multi-robot orchestration

Avoid procuring costly robotics hardware and testing space

Bastian Solutions, a Toyota Advanced Logistics company, produces robot-powered material handling equipment and information systems. AWS RoboMaker multi-robot fleet simulations enabled them to:
Empower customer developer teams to build robot applications that enhance the functionality of Orion Star robots.

Reduce simulation development costs by 80%.

Cut the cost of operating simulators by 40%.
Intelligent robots are enabling commercial automation and improving consumers’ lives. To be competitive in a quickly expanding robotics market, your organization needs to be able to build and maintain intelligent, high-quality robotics applications. Let AWS RoboMaker help improve the way you build robots, so you can get them to market more quickly, safely, and cost-effectively.

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