Space Robotics Challenge backstage

A glimpse at the challenges of running the competition

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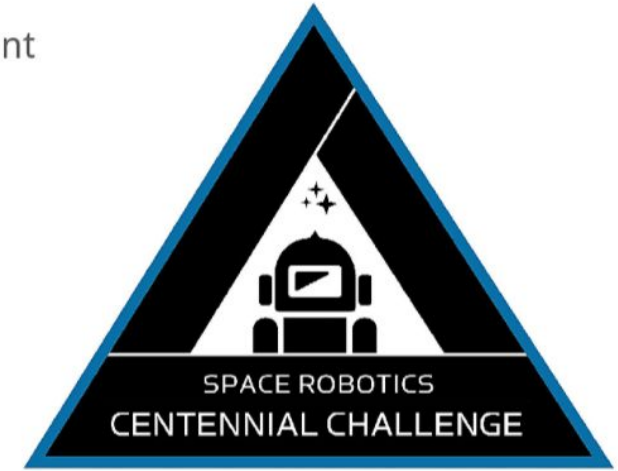
Space Robotics Challenge

- R5 (Valkyrie) robot in Mars environment
- 3 tasks, 18 checkpoints
- Complete all tasks in succession
- Semi-autonomous (or fully!)
- Restricted network conditions
- 20 finalists (from 93 teams)



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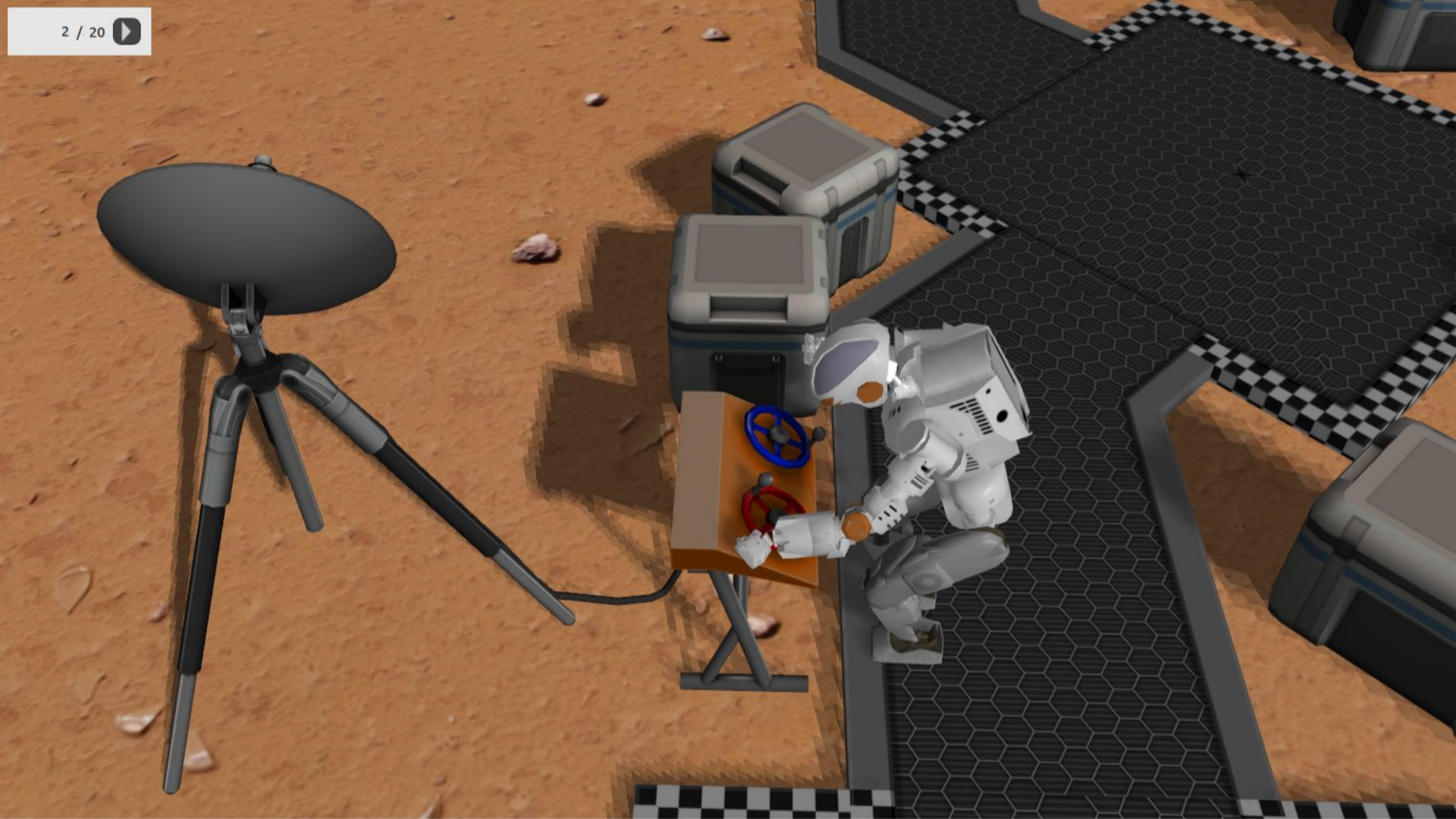


CloudSim for SRC

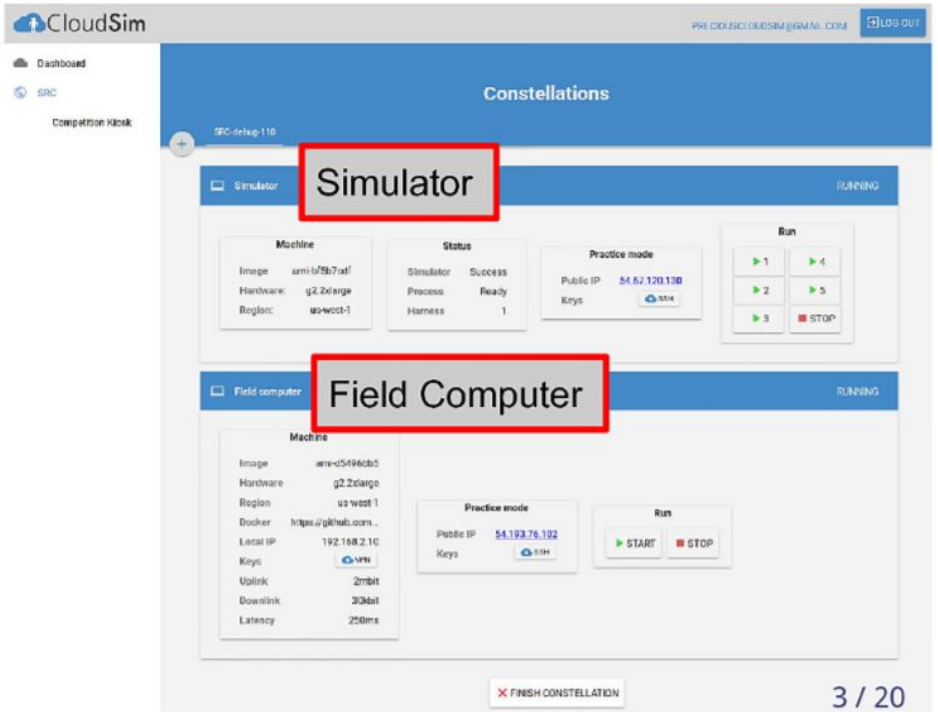
Challenge hosted on AWS

cloudsim.io

Launches constellations
(group of machine instances)

Docker integration

- Reproducible environment
- Team code deployment



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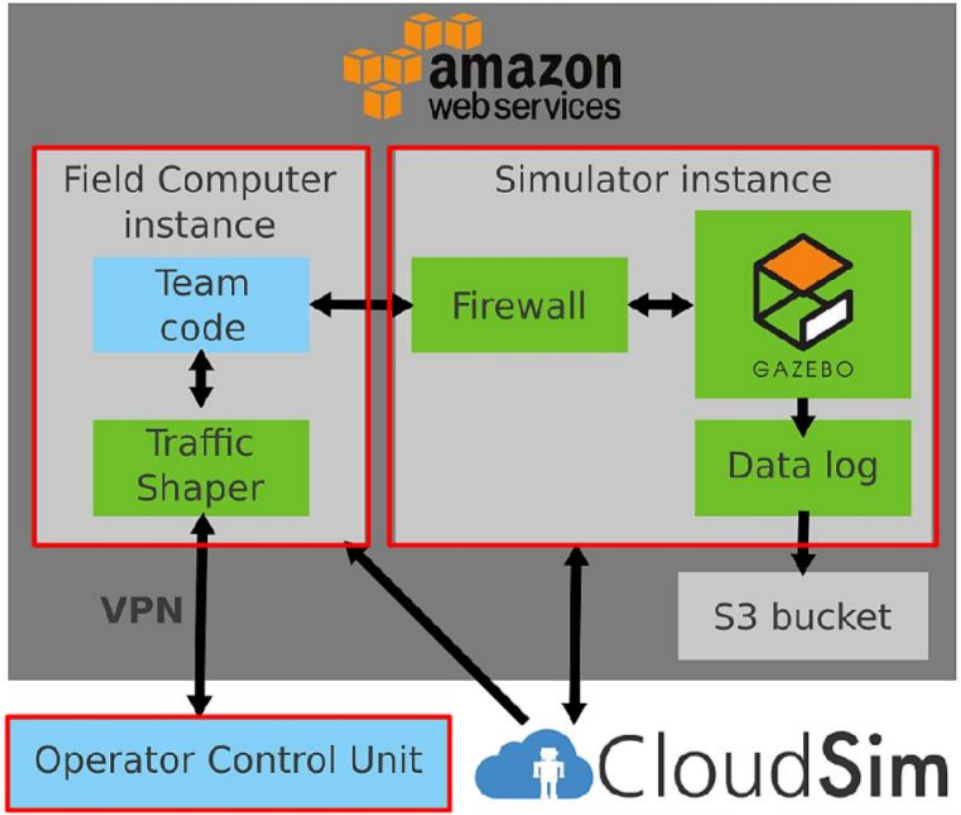
amazon
web services
Field Computer instance
Team code
Traffic Shaper
Simulator instance
Firewall
GAZEBO
Data log
S3 bucket
VPN
Operator Control Unit
CloudSim

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competitors

Hardware interface

ihmc

Whole-body controller

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competitors

NASA

Hardware interface

ihmc

Whole-body controller

GAZEBO

Simulation

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competitors

NASA

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ROS

GAZEBO

Simulation

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NASA

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ihmc

Whole-body controller

ROS

GAZEBO

Simulation

SRCSim

CloudSim

competitors

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SRCSim

- World mechanics
- Real-time scoring
- Restart / skip checkpoints
- Harness
- Log filtering on record

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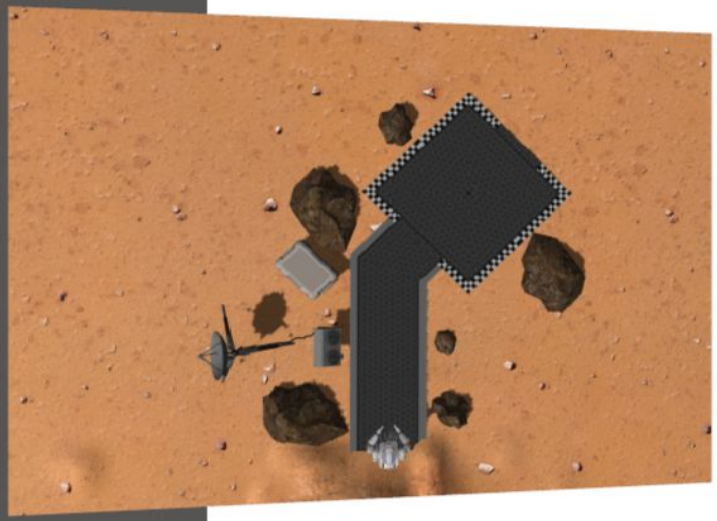
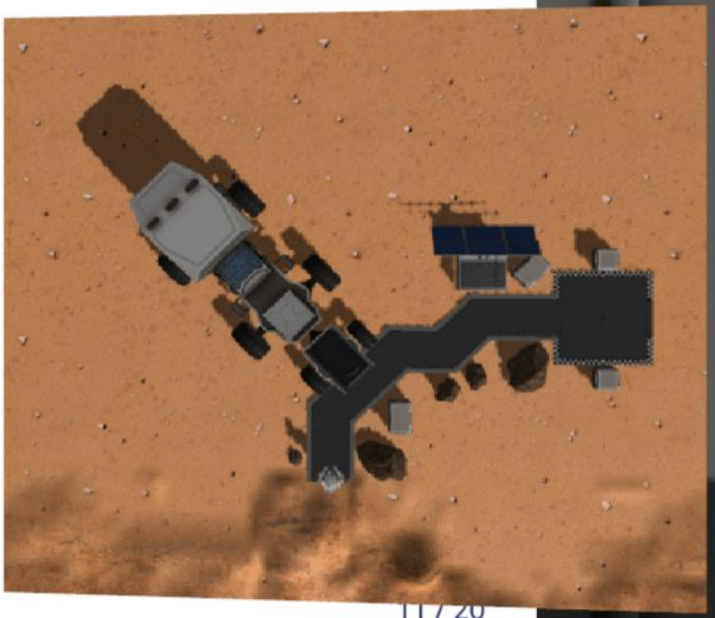
SRCSim - random world generator



- Embedded ruby
- Randomized
  - Configuration
  - Parameters
  - Targets
- Full world or separate tasks



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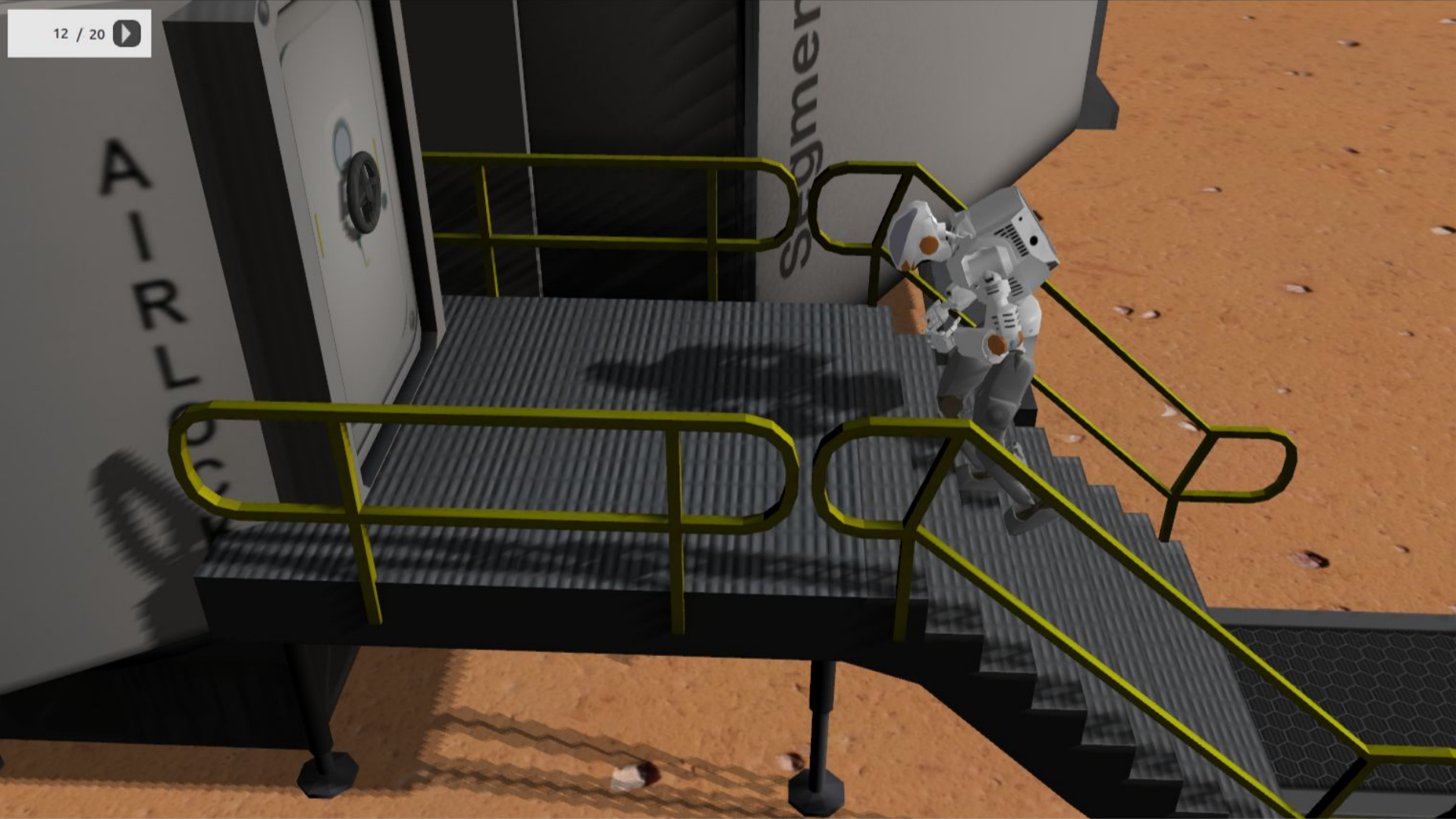
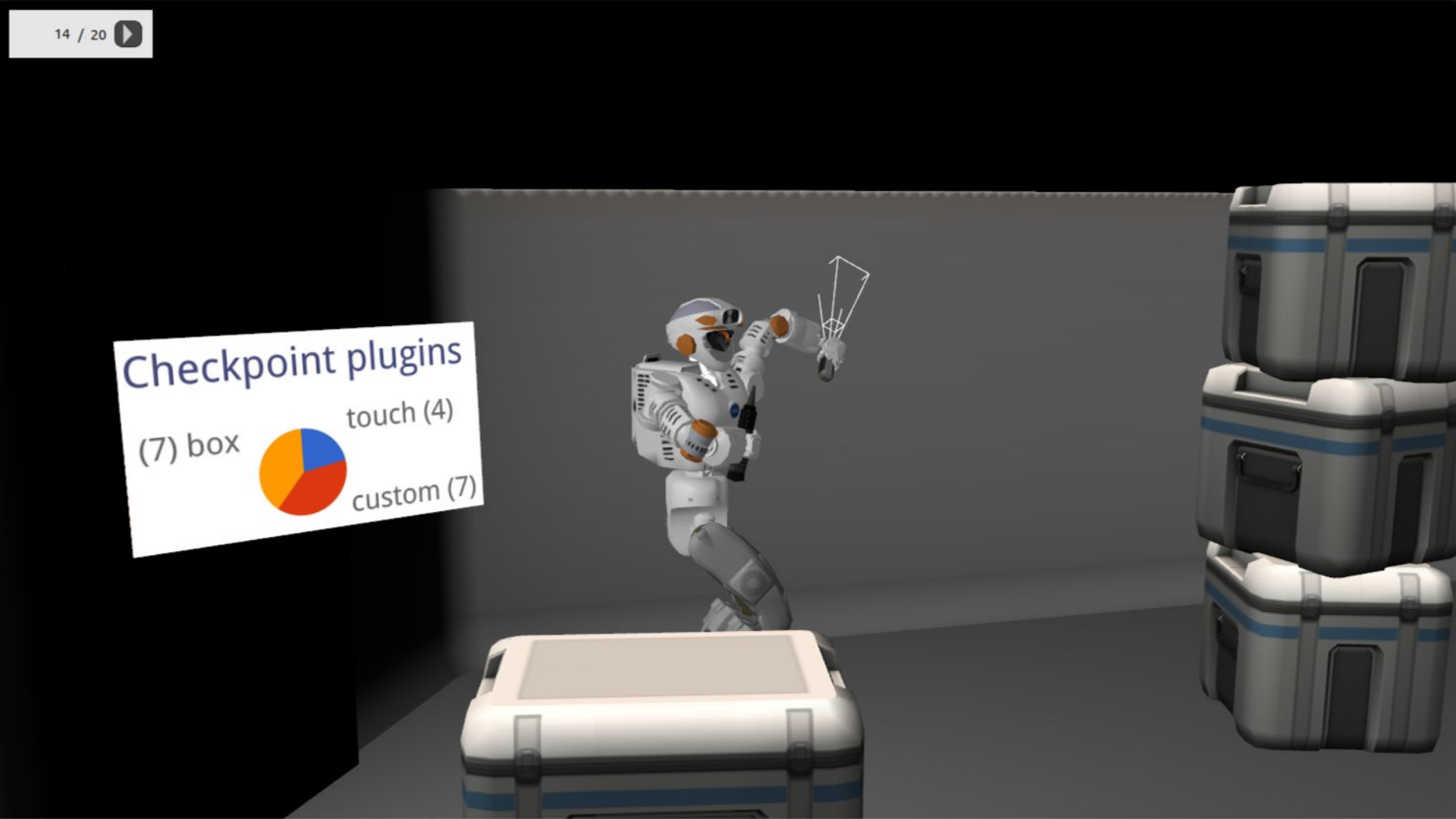
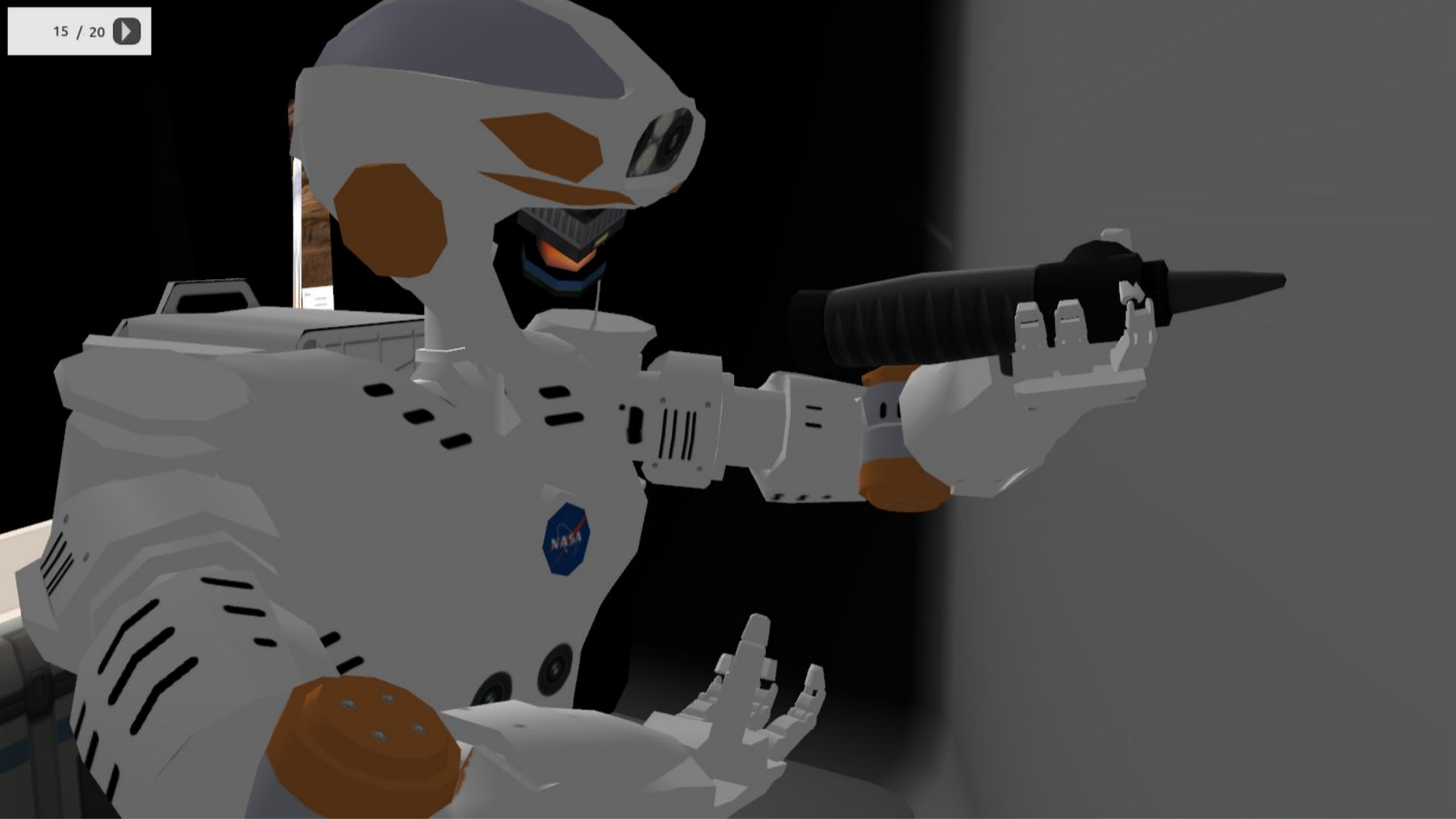

AIRLOCK


leak detector
(logical camera)


Checkpoint plugins
(7) box
touch (4)
custom (7)


NASA

Challenges

Problem: simulation stability vs performance

- Time limit per run: 3.5hr simulation time
- Worst case: 0.1 RTF = **35hr** real time!
- **5 runs** total = **7.3 days!**

Suggestions

- Simple shapes for collisions
- Model insertion / deletion / disabling after passing checkpoints
- Tried relaxing ODE physics solver parameters
  - 2ms step size, reduced iterations
- Try different physics engines

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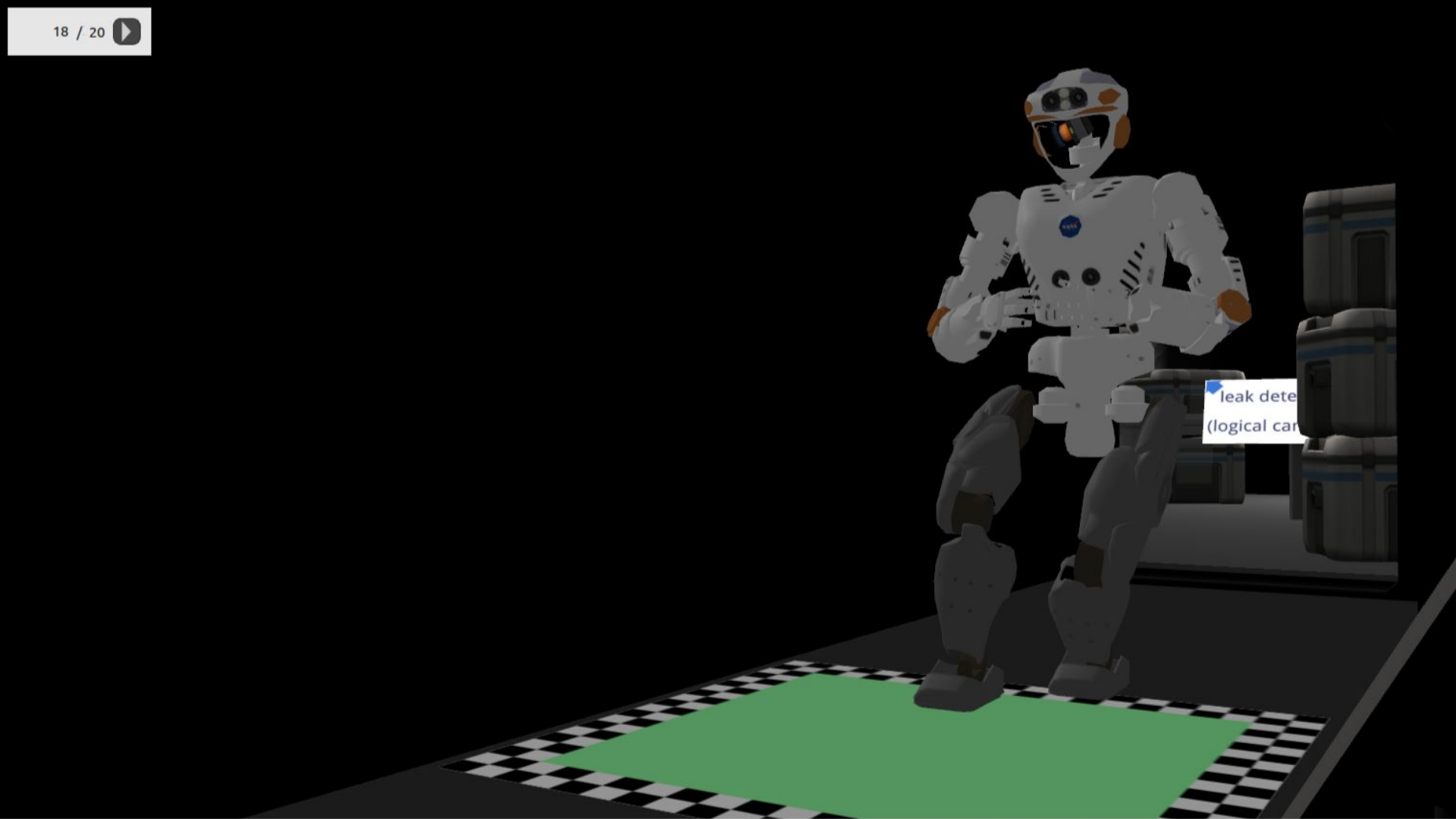
Task Difficulty
Can they be solved?


leak dete
(logical car

Acknowledgements

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EKUMEN

NASA Johnson Space Center

ihmc

3D artist

NASA CENTENNIAL CHALLENGES

NINESIGMA

Thank you!

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