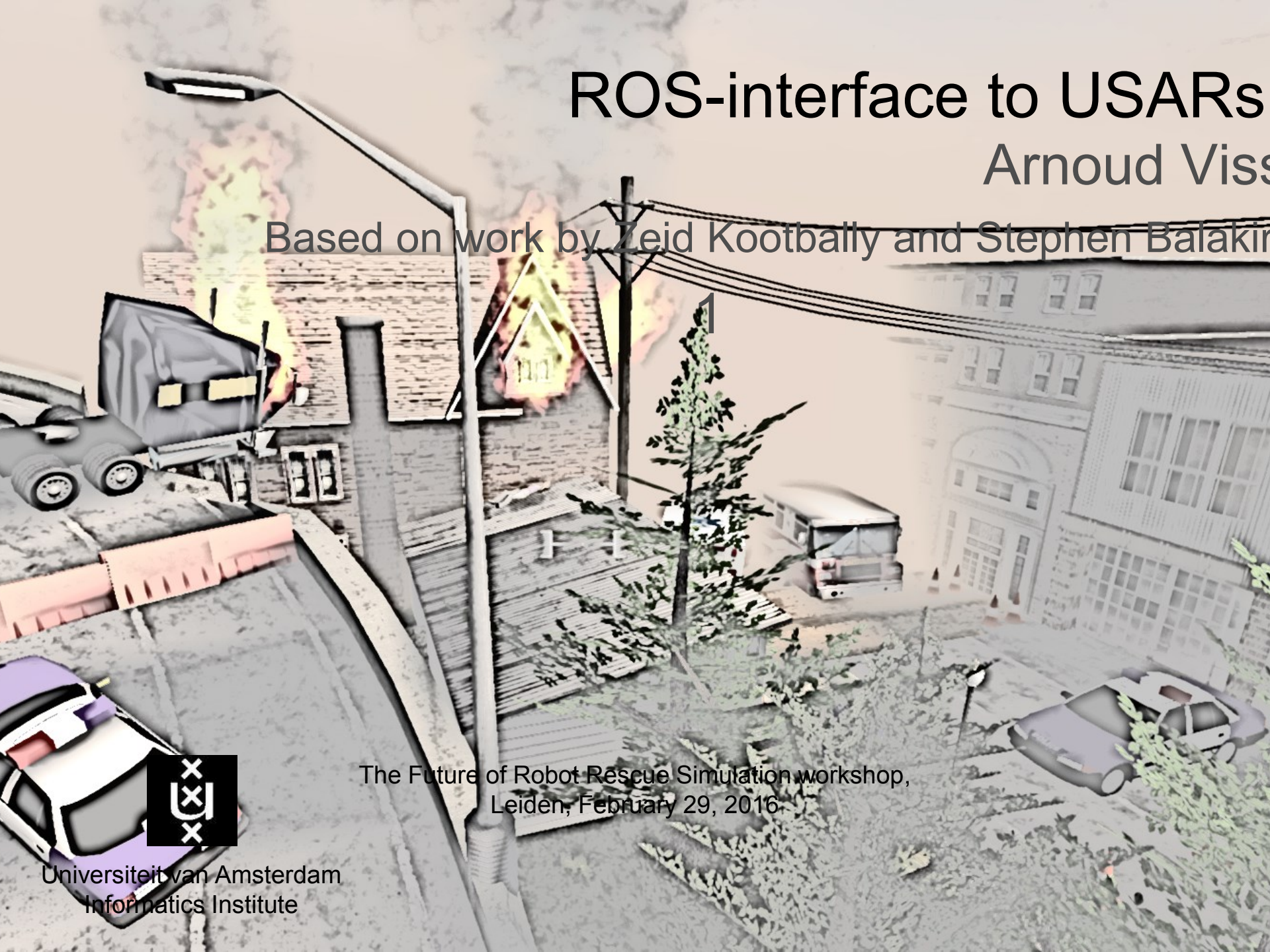


# ROS-interface to USARs

Arnoud Vissers

Based on work by Zeid Kootbally and Stephen Balakin



The Future of Robot Rescue Simulation workshop,  
Leiden, February 29, 2016



# What is USARSim?

- High-fidelity multi-robot simulator developed on top of an existing game engine
  - High performance physics and 3D rendering



- Originally conceived as tool for Urban Search and Rescue (USAR), it has a much broader scope [1]

[www.vmac.org](http://www.vmac.org)

[1] S. Balakirsky, S. Carpin and M. Lewis (2009), "Robots, Games, and Research: Success stories in USARSim", Workshop Proceedings of the International Conference on Intelligent Robots and Systems (IROS 2009), St. Louis, Missouri, USA, October 2009.

# Basic Premise

- Would like to be able to develop, debug, and evaluate cognitive systems
  - Repeatable trials
  - Known ground truth, noise, detections, false detections
- Evaluation environment should provide realism
  - Realistic complexity
  - Tailored data output
  - Environmental interaction
  - Obey basic laws of physics in sensing and mobility

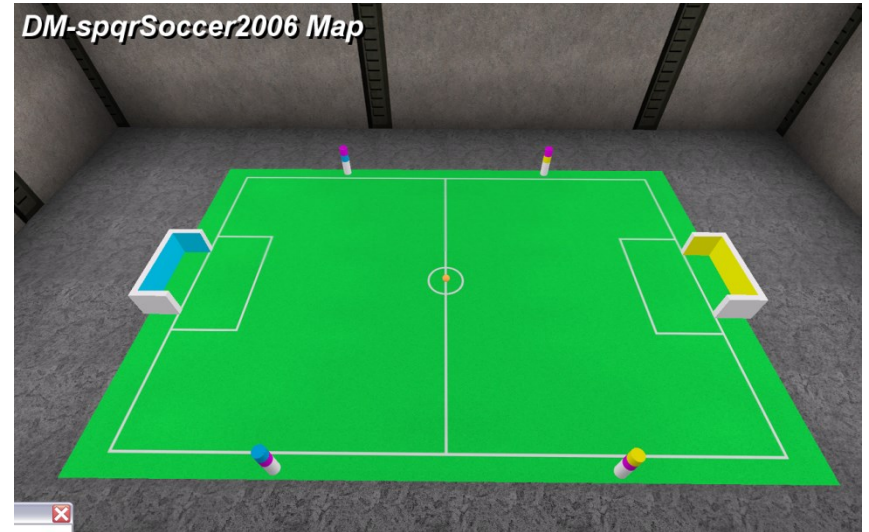
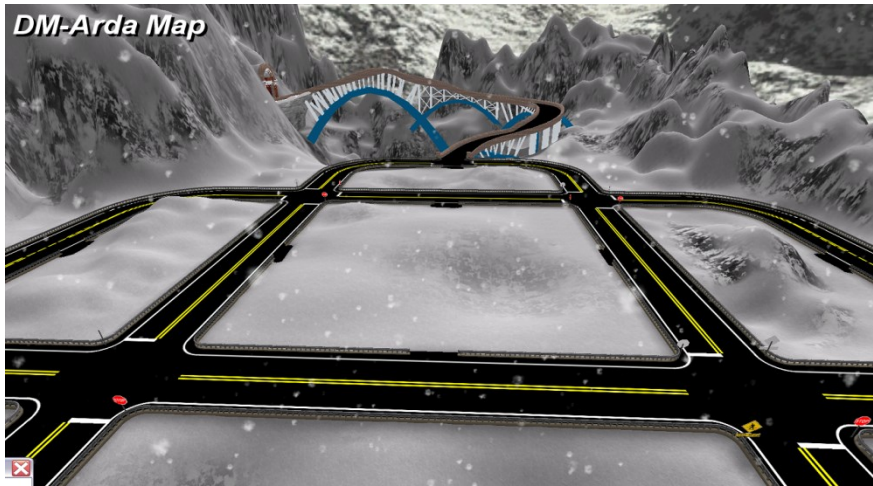


Images from USARSim / MOAST Tutorial

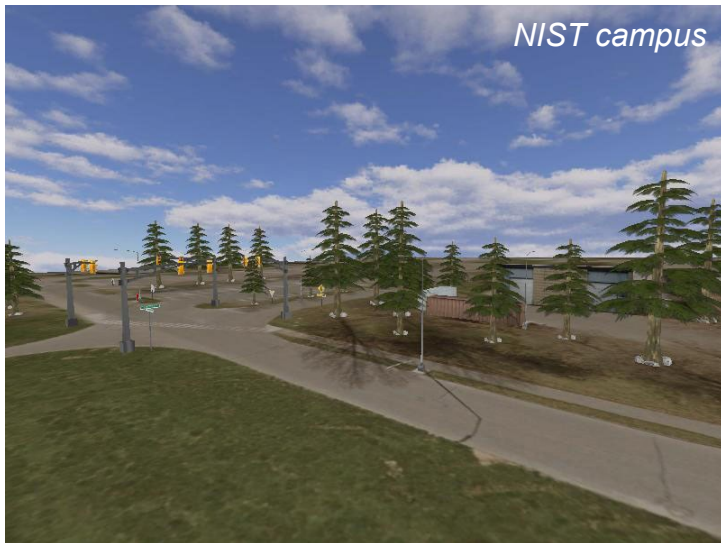
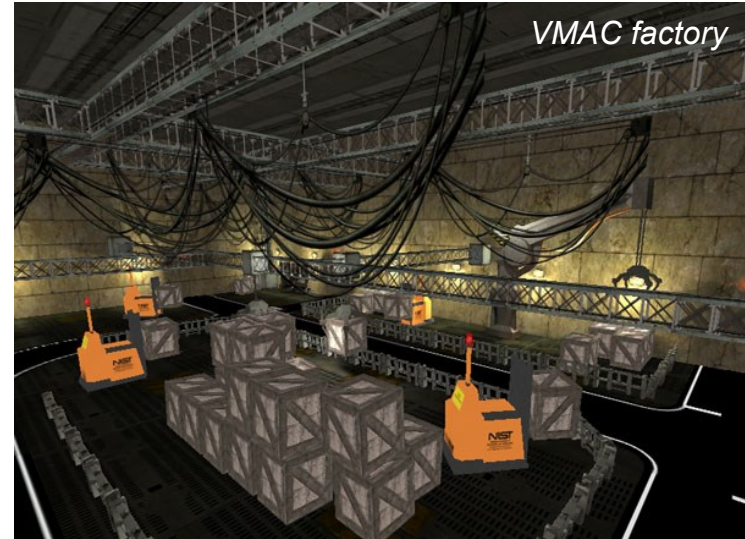
# USARSim variety of platforms



# A wide variety of simulated worlds



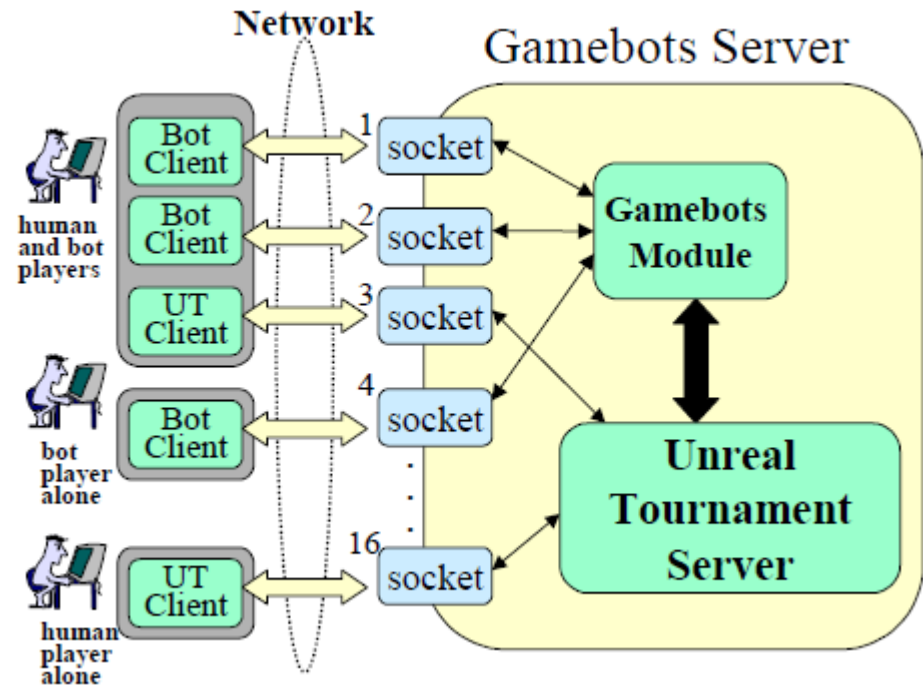
# UDK based simulated worlds



# GameBots is origin USARSim



Screenshot Gamebots [2]



Architecture Gamebots [2]

[2] Adobbati, R., Marshall, A. N., Scholer, A., Tejada, S., Kaminka, G. A., Schaffer, S., & Sollitto, C. (2001, January). Gamebots: A 3d virtual world test-bed for multi-agent research. In Proceedings of the Second International Workshop on Infrastructure for Agents, MAS, and Scalable MAS (Vol. 5).

# Interface defined in 2003



[3] J. Wang, M. Lewis, and J. Gennari (2003). Interactive Simulation of the NIST USAR Arenas. Proceedings of the 2003 IEEE International Conference on Systems, Man, and Cybernetics, Washington, DC, October 5-8., pp. 1350-1354.



# Interface stable since 2013

e.g.: INIT {ClassName *robot\_class* } {Name *robot\_name* }  
          {Location *x,y,z* } {Rotation *r , p , y* }

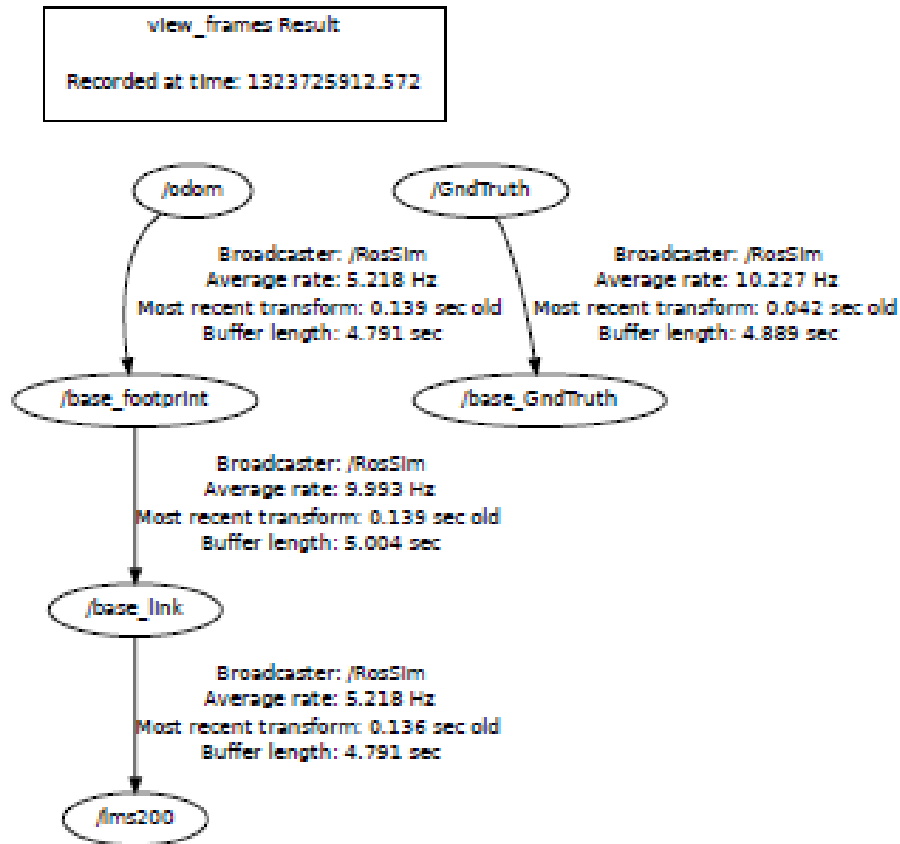
DRIVE {Left *float* } {Right *float* } {Normalized *bool* }  
       {Light *bool* } {Flip *bool* }

GEO {Type GroundVehicle} {Name *string* }  
      {Dimensions *x , y , z* } {COG *x , y , z* }  
      {WheelRadius *float* } {WheelSeparation *float* }  
      {WheelBase *float* }

CONF {Type AerialVehicle} {Name *string* }  
      {SteeringType *string* } {Mass *float* }

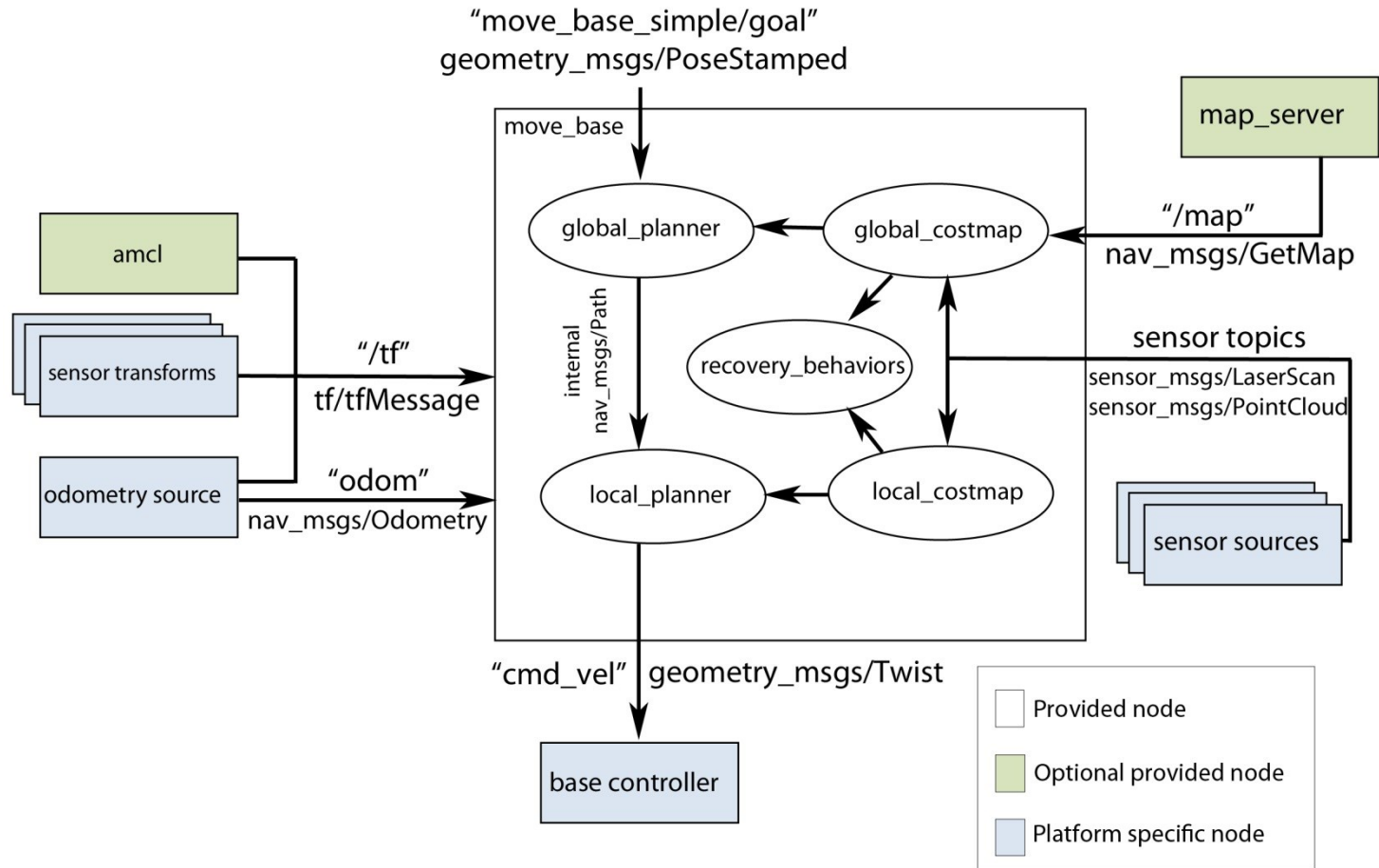
CONF {Type Camera} {CameraDefFov 0.8727}  
      {CameraMinFov 0.3491} {CameraMaxFov 2.0943}  
      {CameraFov 0.8726}

# Interface to ROS



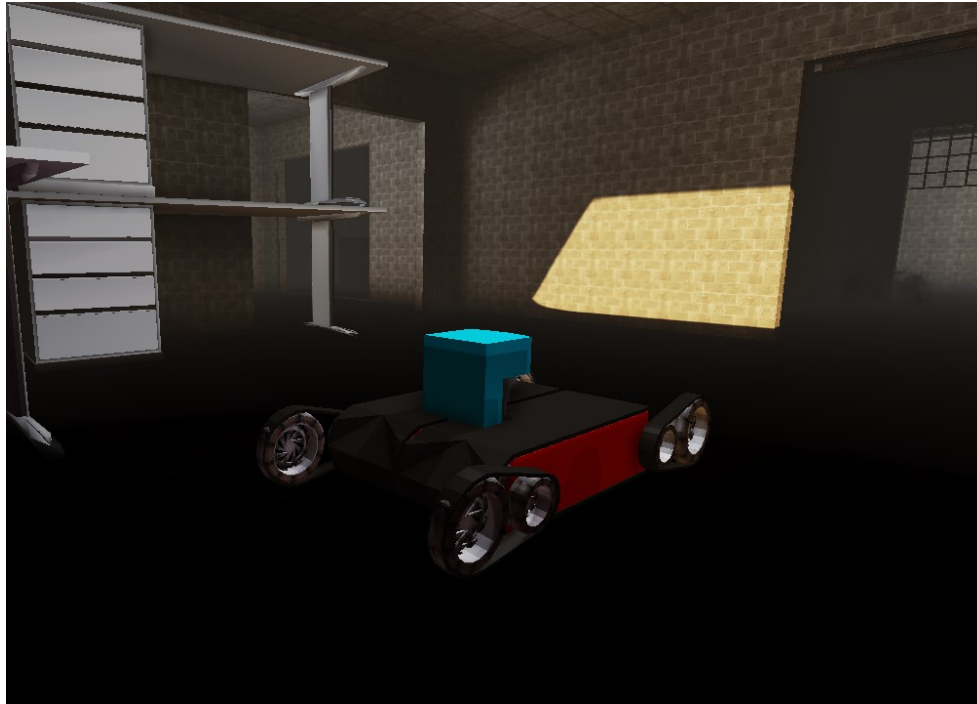
The configuration of a robot is converted into the Transform Trees of ROS

# Coupling to ROS navigation stack

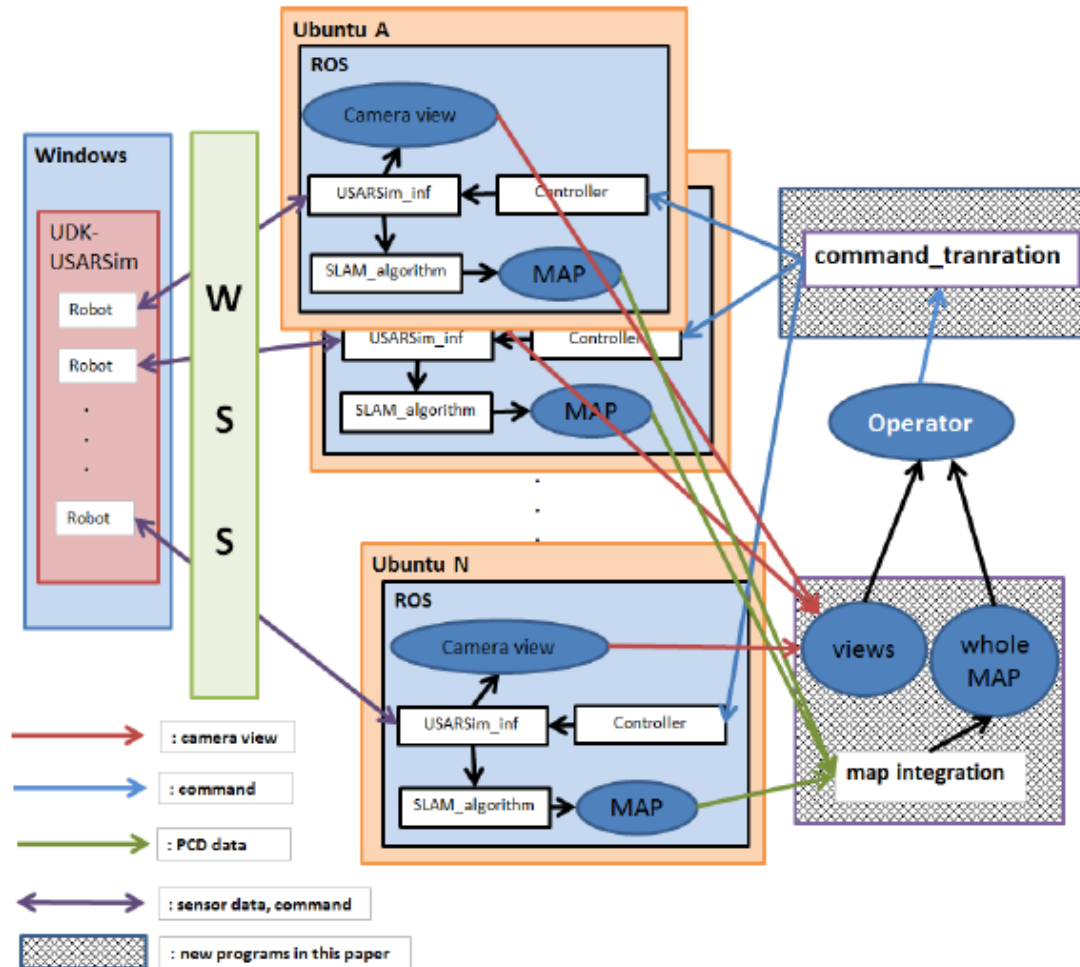


# Example

1. Bring up an environment in USARSim.
2. `$roscore`
3. `$roslaunch usarsim usarsim.launch`
4. `$roslaunch teleop_twist_keyboard teleop_twist_keyboard.py`
5. `$roslaunch gmapping slam_gmapping scan:=lms200 _odom_frame:=odom`



# Adaption by the RoboCup teams



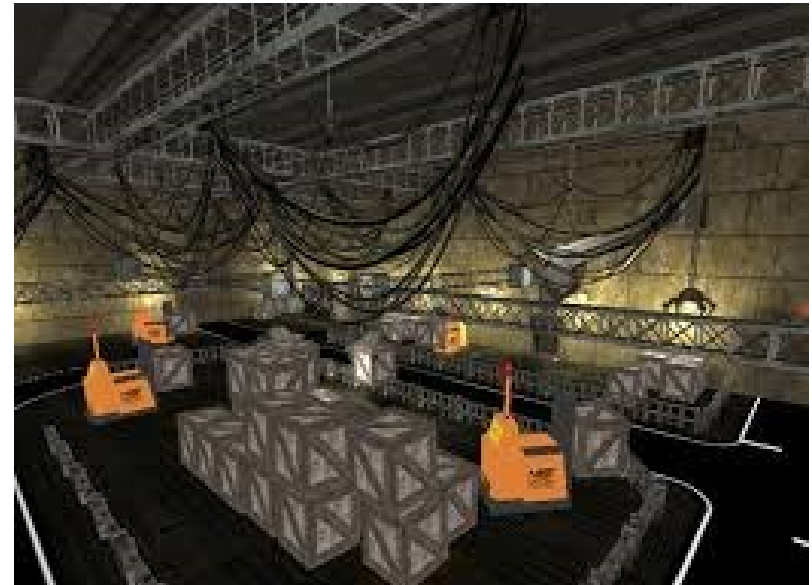
[4] •Sirma Yavuz, M. Fatih Amasyali, Muhammet Balçilar, Yücel Uzun, Khudaydad Mahmoodi, Bilge Yaraş and A. Cüneyt Yavuz: “YILDIZ Team Description Paper for Virtual Robots Competition 2013”, RoboCup 2013 Proceedings, Eindhoven, July 1, 2013



# Conclusion

USARSim can now be used as simulator  
for ROS modules

USARSim is based on a state-of-the-art  
Game Engine, which allows the  
creation of detailed worlds, realistic  
lighting conditions and reliable physics



# [www.robocuprescue.org/wiki/](http://www.robocuprescue.org/wiki/)



## Publications on Virtual Robots and USARSim

If you would like to have your papers added to this list, send them to any of the USARSim/Virtual Robots organizers.

### Research behind USARSim (incomplete chronological list)

- M. Shimizu, N. Koenig, A. Visser and T. Takashi, "A realistic RoboCup Rescue Simulation based on Gazebo", RoboCup Symposium 2015, Development Track, Hefei, China, July 2015 [pdf [📄](#)]
- Z. Kootbally, S.B. Balakirsky and A. Visser, "Enabling codesharing in Rescue Simulation with USARSim/ROS", in RoboCup 2013: Robot World Cup XVI, Springer Lecture Notes on Artificial Intelligence series, volume 8371, July 2014, pp. 592-599. [pdf [📄](#)].
- S.B. Balakirsky and Z. Kootbally (2012), "USARSim/ROS: A Combined Framework for Robotic Control and Simulation", Proceedings of the ASME 2012 International Symposium on Flexible Automation (ISFA 2012), St. Louis, June 18-20, 2012 [pdf [📄](#)].
- S. van Noort and A. Visser (2012), "Validation of the dynamics of an humanoid robot in USARSim", Proceedings of the Performance Metrics for Intelligent Systems Workshop (PerMIS'12), (Edited by Rajmohan Madhavan, Elena R. Messina and Brian A. Weiss), NIST Special Publication 1136 [📄](#), pp. 190-197, National Institute of Standards and Technology, November 2012. [pdf [📄](#)].
- O. Zwennes, A. Weiss and A. Visser (2012), "Adapting the mapping difficulty for the automatic generation of rescue challenges", Proceedings of the RoboCup IranOpen 2012 Symposium (RIOS12), April 2012. [pdf [📄](#)].
- J. Alemany (2011), "Design of high quality, efficient simulation environments for USARSim", Technical Report ICC 2011-10-01, Universitat Jaume I, Castello, Spain, October 2011 [pdf [📄](#)]
- A. Visser, N. Dijkshoorn, M.F.W. van der Veen and R.C. Jurriaans (2011), "Closing the gap between simulation and reality in the sensor and motion models of an autonomous AR.Drone", Proceedings of the International Micro Air Vehicle Conference and Flight Competition (IMAV11), 't Harde, the Netherlands, September 12-15, 2011 [pdf [📄](#)]
- M.N.R. Smith, M. Shaker, S. Yue and T. Duckett (2011), "a Thin Middleware for Simulated Robot Vision Applications," ICCSIT International Conference on Computer Science and Information Technology, Chengdu, China, June 2011.
- D. Miklic, S. Bogdan and L. Kalinovic (2011), "A Control Architecture for Warehouse Automation - Performance Evaluation in USARSim", IEEE International Conference on Robotics and Automation, Invited Session "ICRA Robot Challenge: Advancing Research Through Competitions", Shanghai, China, May 9-13, 2011. [abstract [📄](#)]