ROS-interface to USARs

Arnoud Viss

Based on work by Zeid Kootbally and Stephen Balakir

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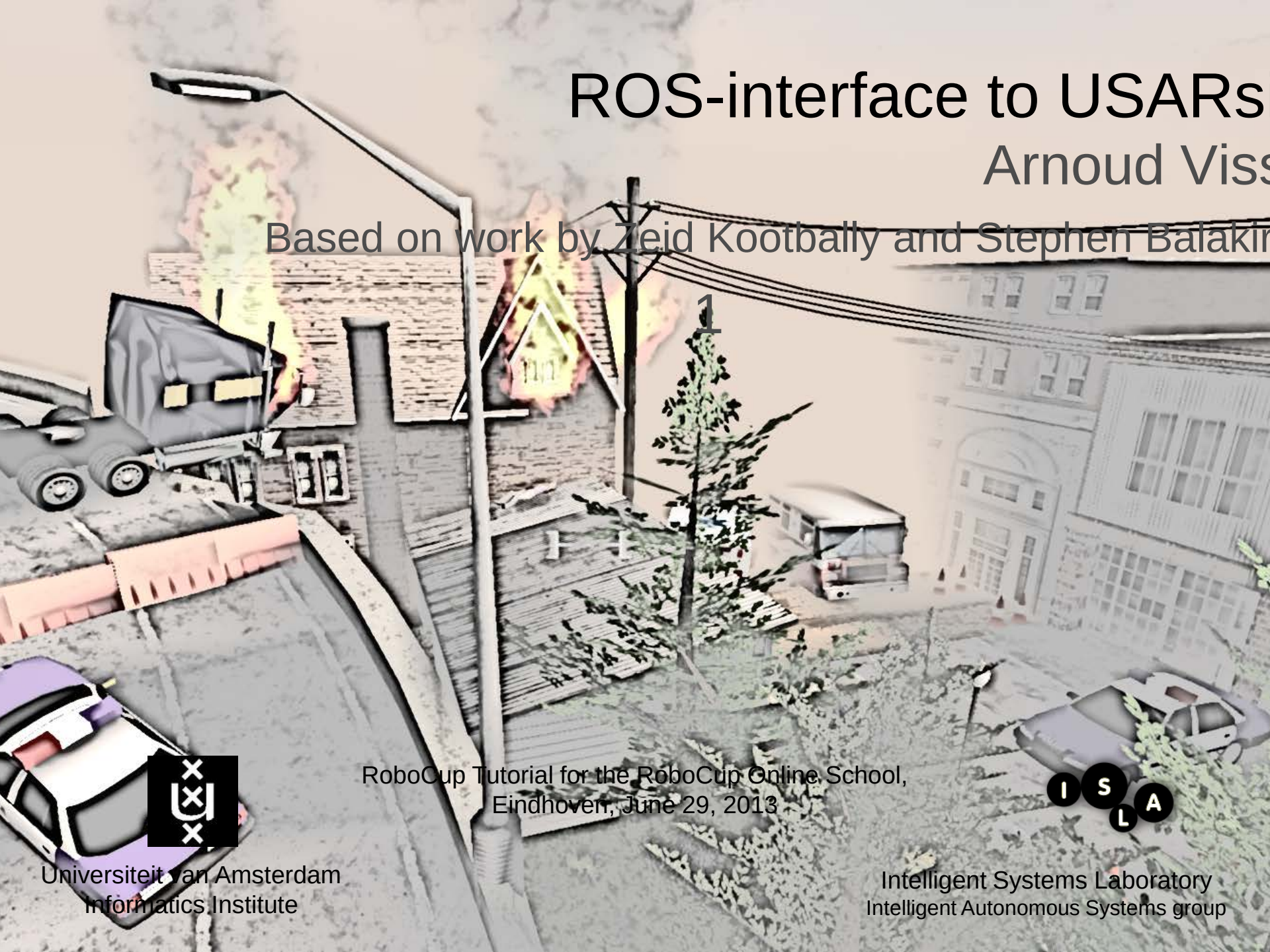


RoboCup Tutorial for the RoboCup Online School,
Eindhoven, June 29, 2013

Universiteit van Amsterdam
Informatics Institute

Intelligent Systems Laboratory
Intelligent Autonomous Systems group

What is USARSim?

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

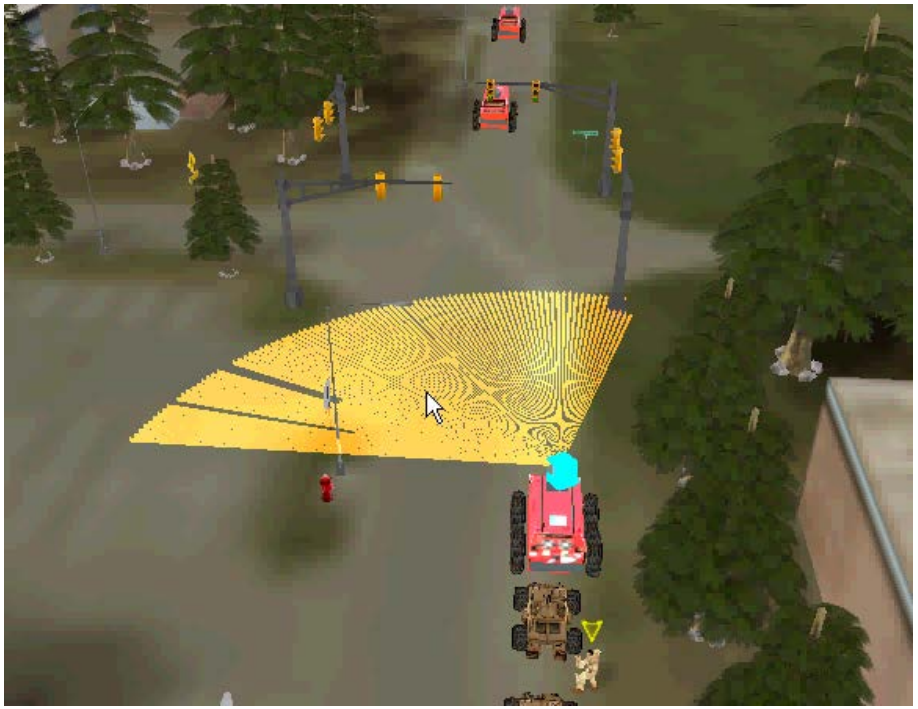
- Originally conceived as tool for Urban Search and Rescue (USAR), it has a much broader scope [1]

www.vmac.org

[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.

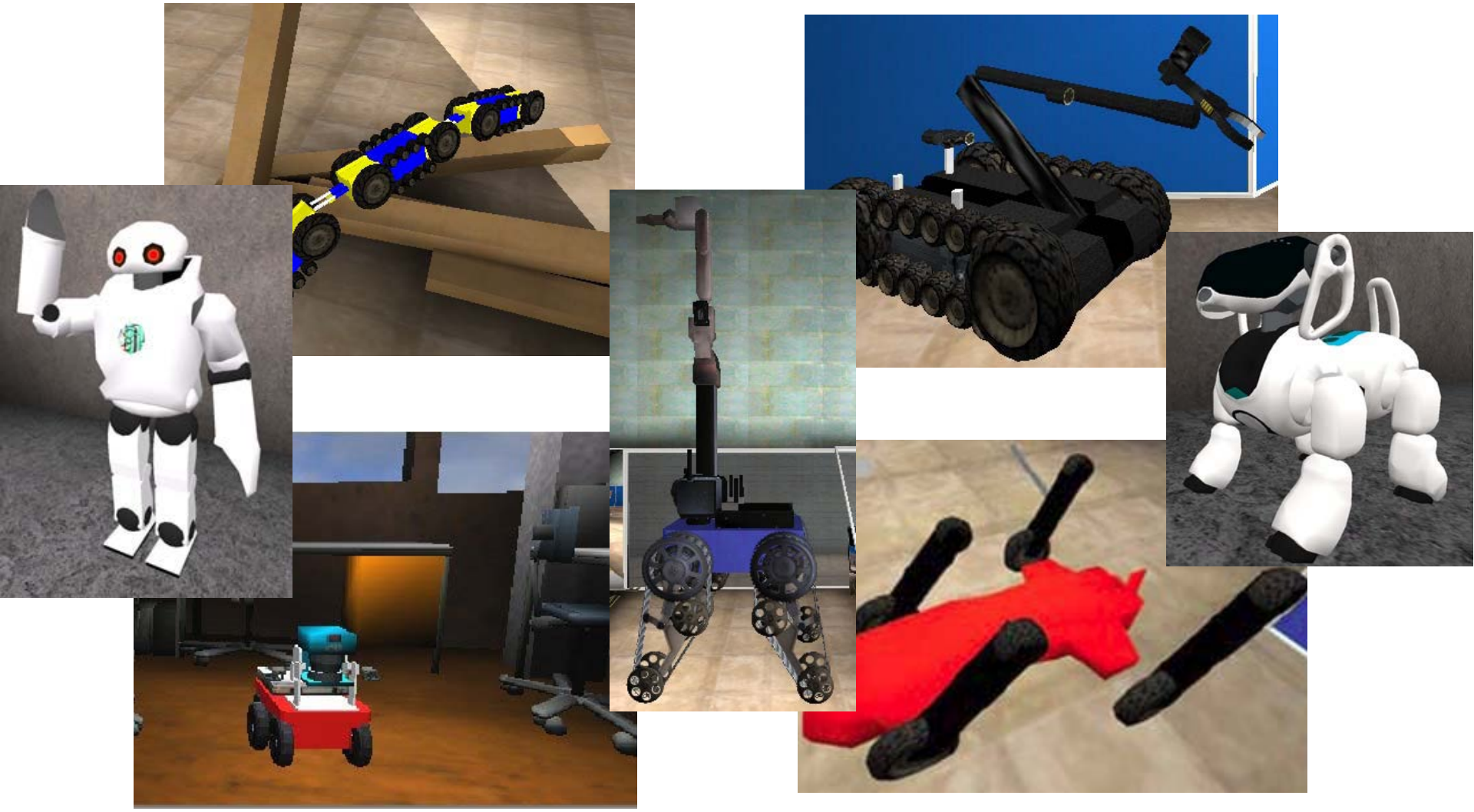
Basic Premise

- 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

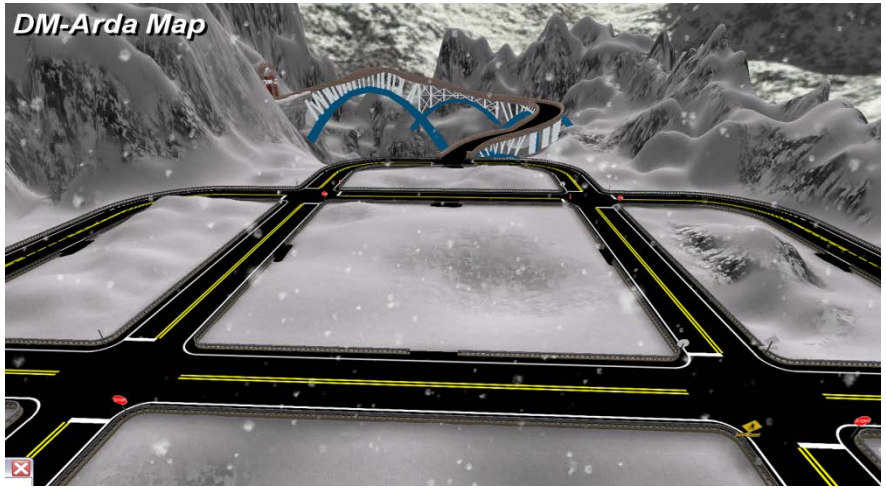


Images from USARSim / MOAST Tutorial

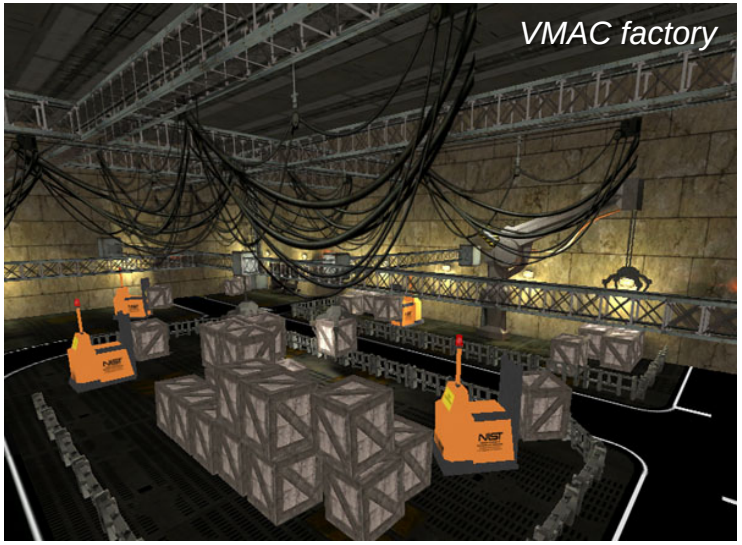
USARSim variety of platforms

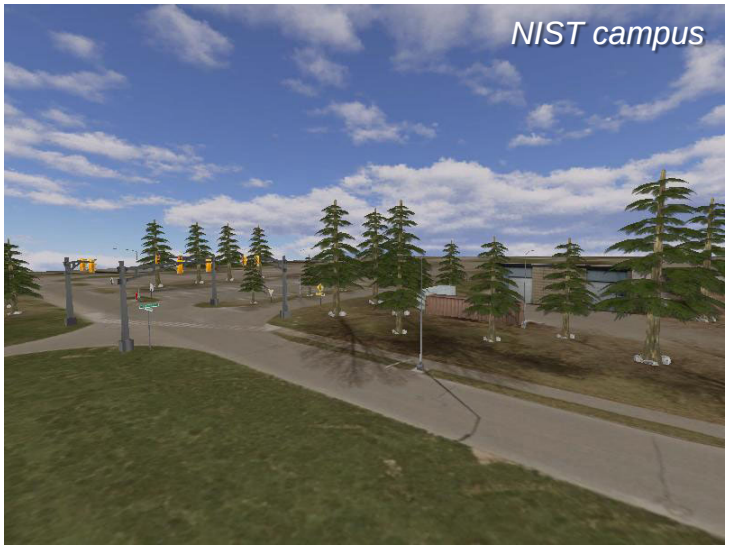


A wide variety of simulated worlds



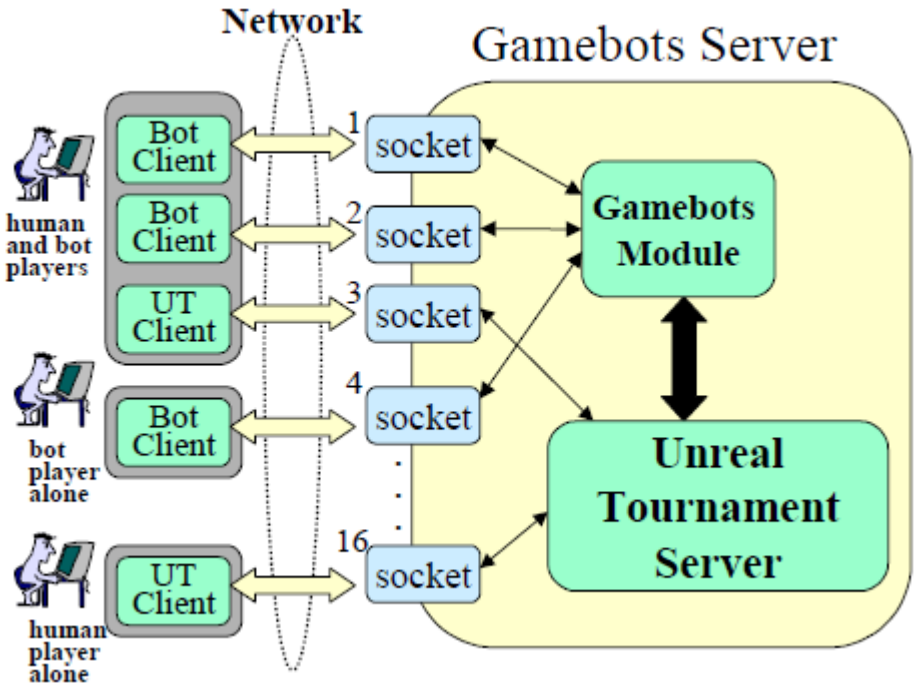
UDK based simulated worlds





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* }

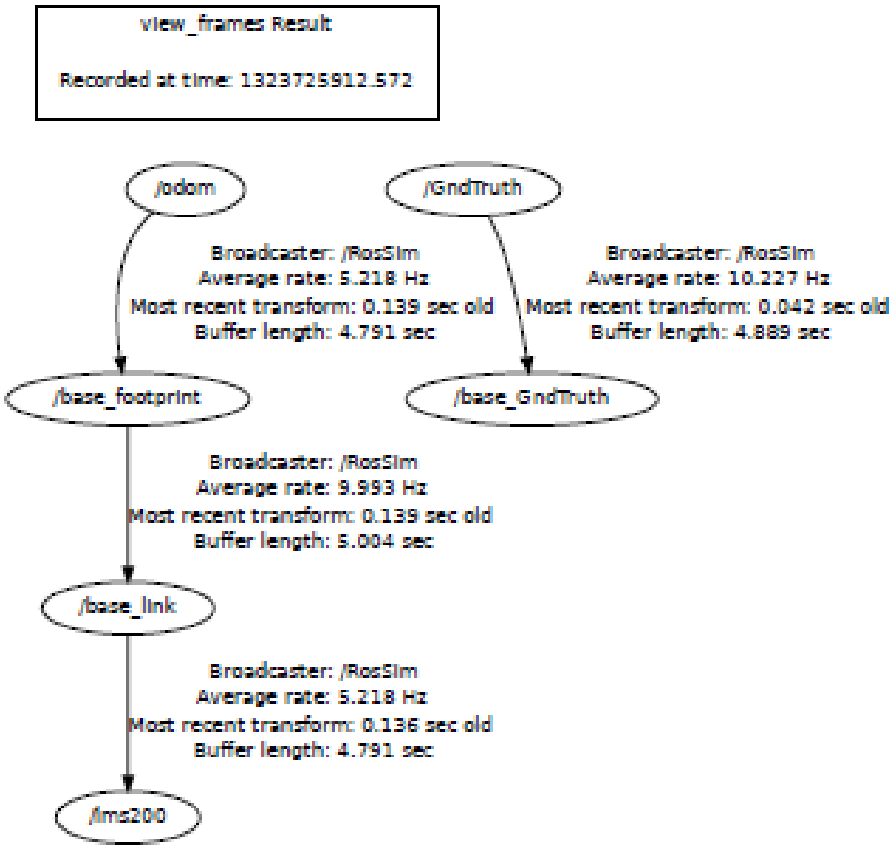
GEO {Type GroundVehicle} {Name *string* }
{Dimensions *x* , *y* , *z* } {COG *x* , *y* , *z* }
{WheelRadius *float* } {WheelSeparation *float* }
{WheelBase *float* }

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

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

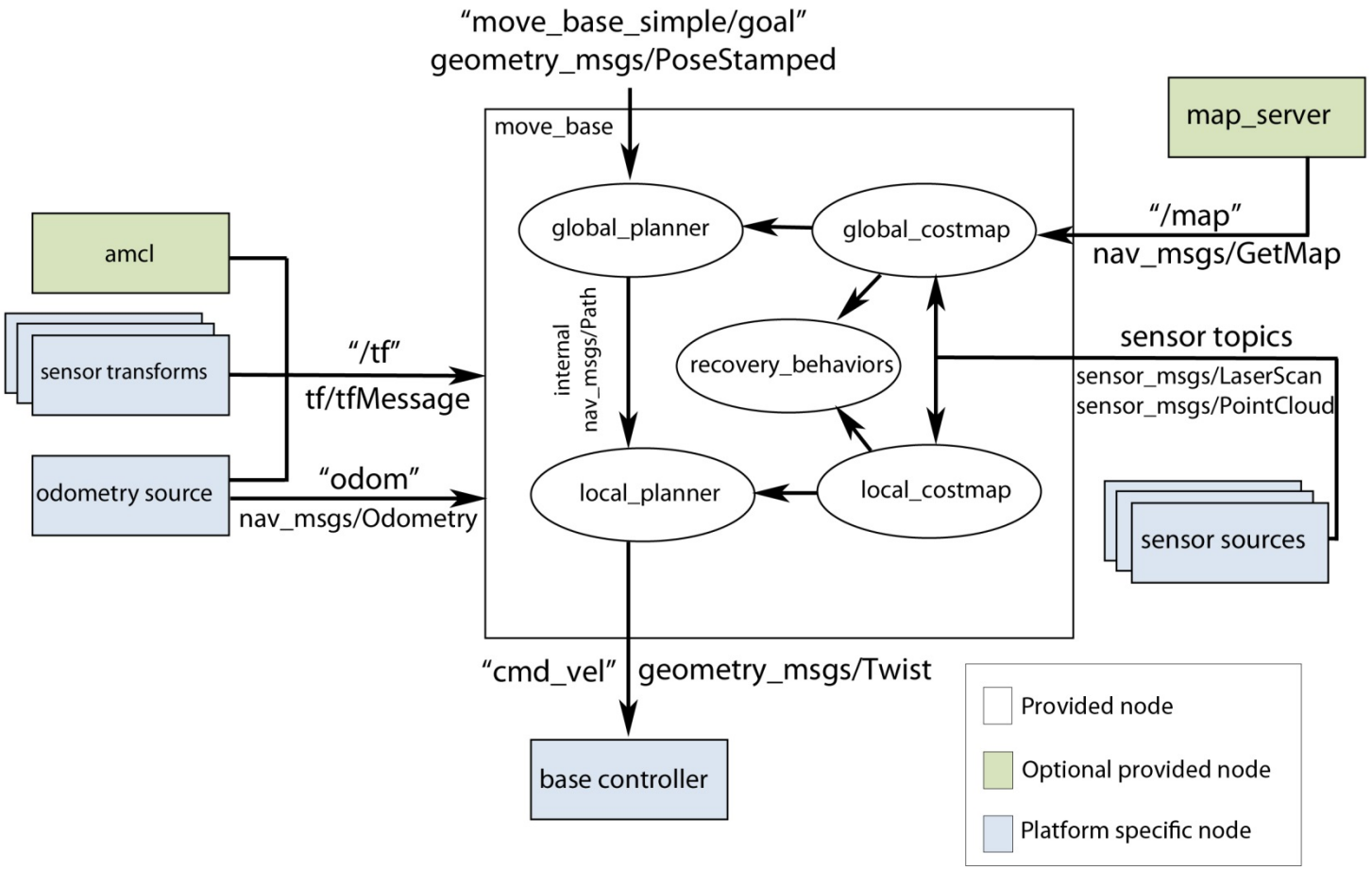
http://sourceforge.net/apps/mediawiki/usarsim/

Interface to ROS



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

Coupling to ROS navigation stack

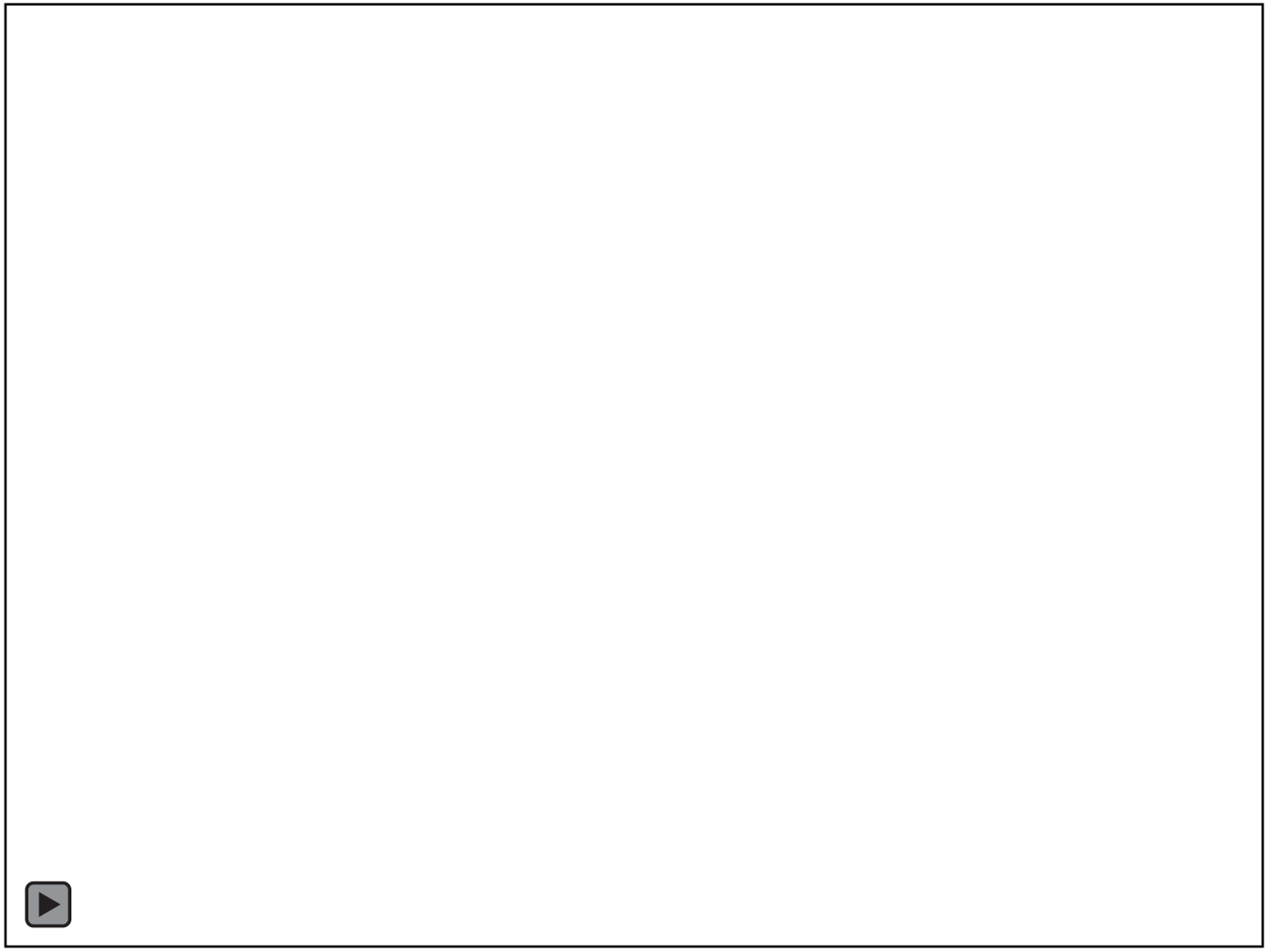


Example

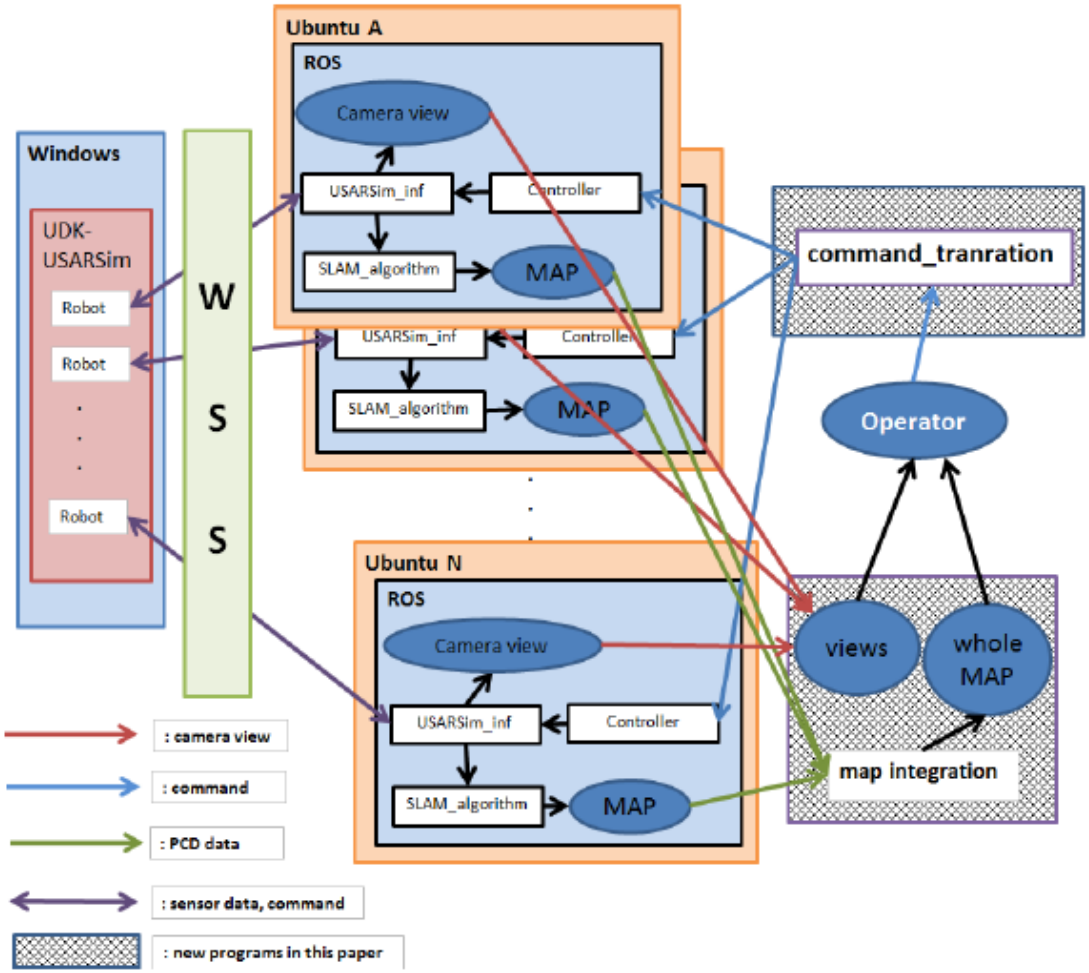
1. Bring up an environment in USARSim.
2. $roscore
3. $roslaunch usarsim usarsim.launch
4. $rosrun teleop_twist_keyboard teleop_twist_keyboard.py
5. $rosrun gmapping slam_gmapping scan:=lms200 _odom_frame:=odom

TeleOperation Example

Autonomous Example



Adaption by the RoboCup teams



[4] •Sirma Yavuz, M. Fatih Amasyali, Muhammet Balcilar, 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

RoboCup 2006 Bremen Germany

3rd place

ROBOCUP ATLANTA 2007

4th place

RoboCup GERMAN OPEN

2nd place

BRAZIL OPEN

1st place

RoboCup 2009 GRAZ • AUSTRIA

3rd place

Iran Open 2010

Development price

Iran Open 2011

3rd place

RoboCup 2012 18 - 24 June Mexico City

Infrastructure price

www.jointrescueforces.eu

Amsterdam Oxford Joint Rescue Forces
RoboCup Rescue Simulation - Virtual Robots Competition

Publications

Publications listed below are relevant to research conducted by UvARescue and Amsterdam Oxford Joint Rescue Forces in the USARSim simulator. For a more extensive list of publications related to this competition see the RoboCup Rescue wiki and the Success Stories on Sourgeforge.

2013

- Zeid Kootbally, Stephen Balakirsky and Arnoud Visser, "Enabling codesharing in Rescue Simulation with USARSim/ROS", To be published in the RoboCup 2013 Proceedings, Eindhoven, July 1, 2013. (PDF).
- Arnoud Visser, Julian de Hoog, Adrian Jiménez-González and José Ramiro Martínez de Dios, "Discussion of Multi-Robot Exploration in Communication-Limited Environments", Workshop "Towards Fully Decentralized Multi-Robot Systems: Hardware, Software and Integration" at the ICRA Conference, Karlsruhe, May 6, 2013 (PDF).
- Francesco Amigoni, Arnoud Visser and Masotoshi Tsushima, "RoboCup 2012 Rescue Simulation Winners", To be published in the Springer Lecture Notes on Artificial Intelligence series, volume 7500, pp. 20-35, 2013 (PDF).
- Sander van Noort and Arnoud Visser, "Extending Virtual Robots towards RoboCup Soccer Simulation and @Home", To be published in the Springer Lecture Notes on Artificial Intelligence series, volume 7500, pp. 332-343. (PDF).
- Maarten de Waard, Maarten Inja and Arnoud Visser, "Analysis of flat terrain for the Atlas robot", Proceedings of the RoboCup IranOpen 2013 Symposium (RIOS13), April 2013. (PDF).
- H.L. Akin, N. Ito, A. Kleiner, J. Pellenz and A. Visser, "RoboCup Rescue Robot and Simulation Leagues", AI Magazine, Vol 34, 2013.
- Maarten Inja, Norbert Heijne, Sander Nugteren and Maarten de Waard, "Project AI - The Darpa Robotics Challange - F.O.O.T.L.O.O.S.E.", Project Report, Universiteit van Amsterdam (February 2013) (PDF).