SIMULATED MARS ROVER MODEL COMPETITION 2013-2014

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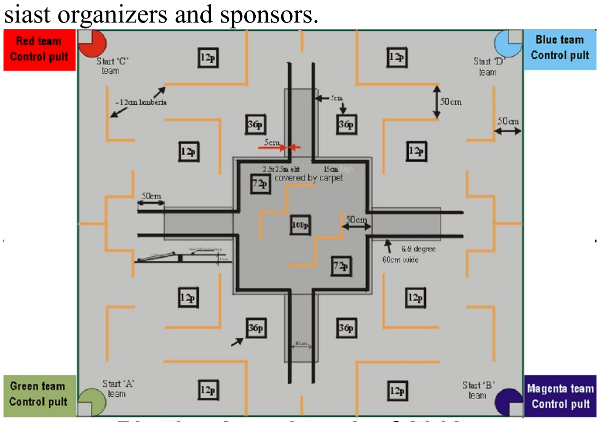
Introduction: This is a report about the organization and management of the Simulated Mars Rover Competition events of 2013 and 2014.

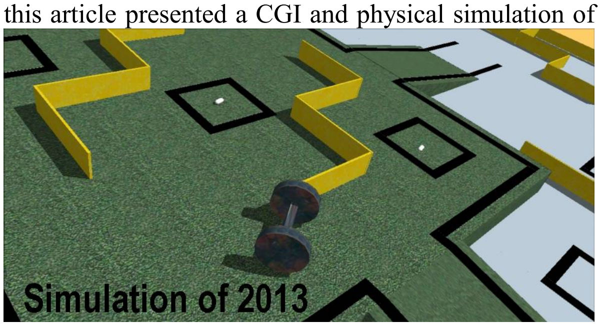
Challenge is the engine of evolution. The young grow old and the replenishment is needed. In every year we take significant effort to organize and realize this traditional competition of applied engineering sciences.

Nine years of success - www.magyarokamarson.hu. [1] ('Hungarians on Mars') We presented in our earlier works (Sipos et al 2009-2011,2013) [2,3,4,5] and (Vizi 2012) [6] the 40th - 44th Lunar and Planetary Science Conferences in 2009-2013. Last year, in 2014 we got an offer to hold the competition at Óbuda-AREK University, (Székesfehérvár, Hungary) together with enthusiast organizers and sponsors.



Plotting board track of 2013

2013 *Simulation and Realisation:* As we explained in detail in 2013 for 44th LPSC [5] the implementation of plot board with targets and scores has been exactly as described there. Moreover organizers and authors of this article presented a CGI and physical simulation of



Simulation of 2013

the dashboard, robot and race before the date of competition. Importance for researching and developing is to reach the capability to supply a good emulation environment before any mission, first at our competition and next in a wide spectrum of planetary environments. Organizers prepared some solutions and presented them before the competition. The style of appearance is entertaining-educational to reach the attention of the possible younger competitors also, similar to a sci-fi movie trailer. [10]

Solutions of competitors Double wheel vehicles had built by competitors gave a variety of mechanical and sensor based balance solutions. Several robots had straddle wheels to ensure balance, together with low center of mass below the axes of wheels.

This necessity emphasized the importance of size reduction also." The full length final round visible at video sharing site (trailer included at the beginning until 0:58) [11]

Success of research goal of 2013 Teams started after a random draw, the 15 minutes mission time was enough to bring the better solution and the rest of mixed qualification with summarized scores gave the best and talented winner. Track was visible; because of cheap and small remote camera solution doesn't make harder the race but makes more expensive the preparation, but human commands was delayed for 10 sec.

Competitors invited experts from other knowledge or studied them. Planetary research specific goals reached in the next fields: autonomous navigation, climbing and artful winner strategies observable in videos during reach the differently scored targets.

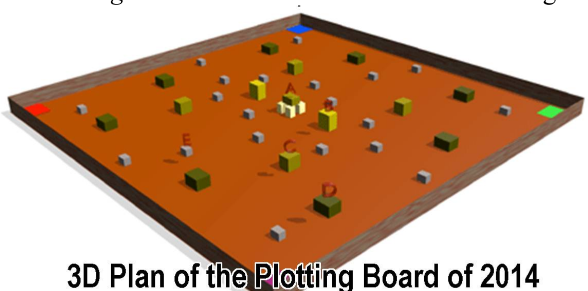
After a good race sight of the excited competitors is always a good feeling.

2014 *Plan and scientific goal:*

The challenge this year was more sophisticated than before when the automatism and self control were interesting for models but was not dependent on milliseconds: manual remote control and in situ onboard closed-loop. The more quicker and automated self onboard closed-loop and fuzzy logic, the more chances to fast solve the problem to win. Price of microchips and microcontrollers this time are low but sophisticated skills must be learning using those new cheap parts.

The plan and the mission were: To build an air cushion vehicle driven robot, which was capable to put lump sugar sized dices onto top of the different sized boxes. It was necessary to make a control glove (real or virtual) for one hand to control the rover by fine movements of the hand and fingers. Delay was not necessary this year, because speed was important indeed to keep the competition seamlessly, but this time 'satellite' map was not available from a camera above the plotting board.

Plotting board: 8m x 8m with different targets.



3D Plan of the Plotting Board of 2014

Targets and scores: On the plotting board were placed 15 target boxes, their size were 0.2m x 0.2m as its base and their height were in order 0.1m, 0.2m and 0.3m according to their score; also there were placed obstacle objects to make the race harder. Scoring was similar to last year, 108;72;36;12 by hardness. *Targeting objects, dices:* Targeting objects were 20 dices per competitor. *The robot:* Size of an air cushion vehicle was necessary to be 0.5mx0.4m. Allowed overhang of the robotic arm was maximum 0.3m. The recommended robot had five functions: 1st to turn on and control the air cushion motor, 2nd to control the steering jet, 3rd to control a necessary robotic arm, which can handle dices, 4th to drop dices and 5th to pick up and store them. Robots were permitted having a gyroscope. Any hardware was allowed to help the self control of the robot. *Safety:* All the robots should be able to brake safely. All the quickly rotating parts were necessary covered with a stable protecting grid or mesh. *Fighting:* Robots were allowed to fight each other with propulsion or with robotic arms.

Control and navigation: Control gloves or hand movement recognizers were acceptable. Hand and finger movement recognition cameras and software or gesture recognizer integrated circuits were useable. Control gloves were permitted to contain gyroscopes.

Planetary research specific features: Quick and accurate integrated remote and self control strictly necessary during space mission operations, e.g. near space stations in space or on the surface of a planet, or at NEO asteroids, etc. During manual remote control all of the independent reliable local automated operation needed to protect the robot against any damage during operation, like overrunning and bumping. In a planetary mission it is necessary to put down and populate measuring devices and to collect them back. Dynamics of a hovercraft machine can simulate the inertia in microgravity, but only in 2D.

Virtualization: Organizers made and make virtual traces for the race already months before the competition in this year also. Mission animations are watchable on YouTube from 2010. [7,8,9,10,11,12]

Simulated and real version of any place

Conclusion: Competitors have to be capable of designing, developing and constructing complex robots, and moving them by driving in order from wheel and caterpillar, through amphibians, elevator climbers, legs, balanced double wheels and air cushion (2006-2014). During the competitions a lot of sensors, manipulators and tricks were used. We hope that a prize will be awarded thanks to the gratitude of our sponsors, media covers our events, and competitors join the work of Universities and research institutes. [13]

Competitors of 2014

References: [1] SIPOS, Attila et al. (2006-) www.magyarokamarson.hu [2] SIPOS,A., VIZI,P.G.: LPSC40 #2519 [3] LPSC41 #2649 [4] LPSC42 #2014 [5] LPSC 44 #2850 [6] VIZI,P.G.: LPSC 43 #1825
[7] VIZI,P.G.: (2010) youtu.be/2vO7AgGn-3I
[8] VIZI,P.G.: (2011) youtu.be/TGOdS-WnKi4
[9] VIZI,P.G.: (2012) youtu.be/Z0nyy8PmsX4
[10]VIZI,P.G.: (2013) youtu.be/12nfduYfBOE
[11]VIZI,P.G.: Galileowebcast.hu: (2013) youtu.be/-xBdFWQA2U4
[12]VIZI,P.G.: (2014) youtu.be/aXpx6pdqCgU
[13]Galileowebcast: (2014) Final round or Mp4