SIMULATED MARS ROVER MODEL COMPETITION 2012-2013

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Introduction:

This is a report about the organization and management of the Simulated Mars Rover Competition events of 2012 and 2013.

www.magyarokamarson.hu [1] ('Hungarians on Mars'). This is an annual, traditional competition of applied engineering sciences for eight years now. We covered it in our earlier works before (Sipos et al 2009-2011) [2,3,4] and (Vizi 2012) [5] the 40th - 43nd Lunar and Planetary Science Conferences in 2009-2012. As usual, we reported about the gathered experience and results usually at the place of the tournament in II. Rákóczi Ferenc High School, Kiskunhalas, Hungary and Óbuda University, Budapest, Hungary in 2010 and the new place Déri Miksa High School, Szeged, Hungary in 2012 and 2013. Organizers of the competition are independent persons and organizations who work together with High Schools and enthusiastic sponsors. The founder and the main organizer of the competition from the beginning has been Mr. Attila SIPOS electrical engineer

Discussion:

Ideas: To get more and more experience is one of the most important things nowadays and in each year and so is it when we offer another challenge. In order to achieve the automatism and to simulate time of signal spreading, human commands to robots must be delayed by 10 seconds in 2013. The jury machine works now automatically, only results are important, but there are experienced members in the jury and among them the author of the present paper.

Mission 2012

2012 results "This year we found spider like organisms on Mars (or on other planetary target) which reproduce themselves from eggs. It can be dangerous for us if they multiply themselves. According to our reconnaissances if we can occupy their oviposition places by putting our 'eggs', then we can win. Our robots must go on foot, because if we do so, the spider like organism does not want to attack us. If we use wheels, then they immediately attack us."

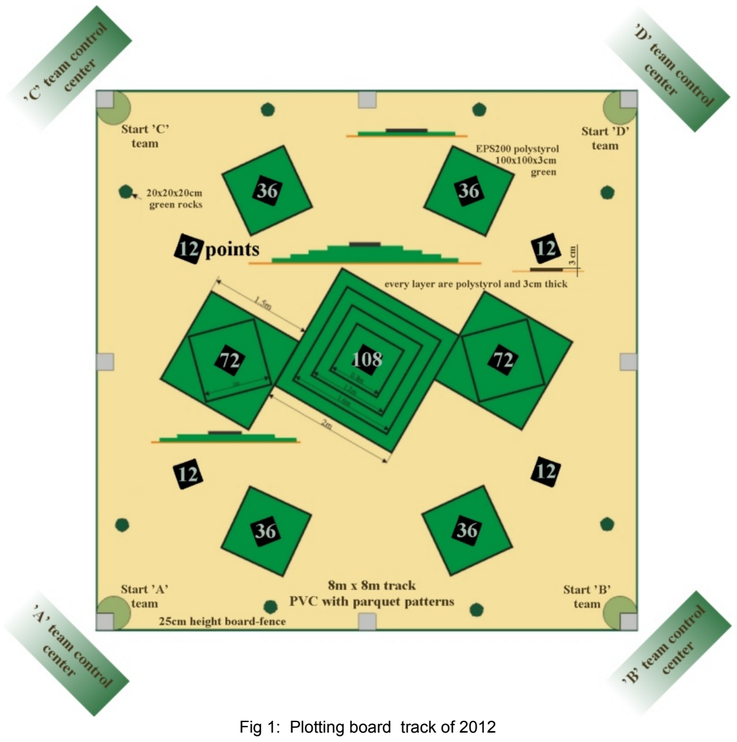

Fig 1: Plotting board track of 2012

Limitations: Going on foot and jumping were allowed, but flying was impossible (because of thin atmosphere or quick winds). Size and weight were limited for robots; the maximum diameter was half a meter and mass could be maximum 2 kg. In case of any collision the mission was needed to be restarted, furthermore necessary to take care of other robots.

Mission: One mission could last max 20 minutes for four teams. Robots fight against the enemy and had to have more scores than the other groups. The scores came from better oviposition places from 12 to 108 points. Missions started with a draw and after it they continued by earned scores. Three rounds of matches gave the final result.

Control: Human commands had to be delayed for 15 seconds. The track was visible for *the teams as in 2011 (because of cost limitations and it is easy to get pictures from robots nowadays).*

The main scientific goal in 2012: The main scientific goal in 2012 was to implement legs for robots: to learn mechanical knowledge or to involve more mechanical engineers into design and competition. During years competitors were mainly electrical engineers and IT specialists. They should invite mechanical engineers or should acquire mechanical knowledge to build stepping robots, e.g. hexapods.

Planetary research specific features: Different objects, like layers were be placed on top of each other on the plotting board to make the task difficult enough to reach and to climb the targets. Different scores for goals increased the significance of a better strategy. Command time delay and automatism supported the independent reliable operation.

Competition with ovipositing hexapods: They were similar to the 'alien life form' and were related to a not-too-distant future when micro robots may multiply themselves with eggs. A short description from the trailer video[6]: Any stepping mechanism, 9 reproductive fields and 9 eggs, 4 robots together at the same time on 'Mars', HD resolution satellite picture but only in 1fps 15s delayed control.

Virtualization: Organizers and competitors can make virtual traces for races already months before the date of the competition, see Fig 2. Mission animations are visible on the youtube.com from 2010 [7,8,9]

Fig 2: Virtual reality animation and preview video of Mission 2012

Fig 3: Winner solutions – Hexapod category (left) and the absolute winner (right)

Fig 4: Live webcast and archive from the Competition: galileowebcast.hu

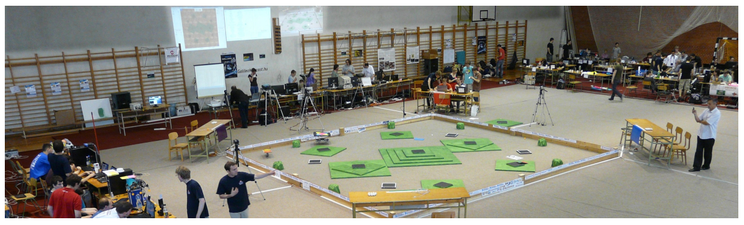

Fig 5: The place of the event at Déri Miksa High School, Szeged, Hungary

Fig 6: Happiness and Celebration

Mission 2013

2013 plan: Annually we wrote a short action sci-fi tale for the competition. "In Mars City the eggs occupied in 2012 must be put into safe place immediately which are inside of the maze of the city. To fulfill the mission is hard because of the labyrinth of the city. There is chance only for doubled wheel vehicles which can navigate between narrow streets and corridors."

Mars city: We will build a carpet-covered track visible on the Fig 7, which is the proportional map of the city. Maze is built from wooden fences, 12 cm high and 1 cm thick. The center of the city is 15 cm high, reachable through a 60 cm wide slope. The edges of maze streets are enhanced by black adhesive tapes, which can improve the positioning of autonomous robots.

Targets and scores: The track contains 15 valuable places. To earn scores, it is necessary to put 'naquadah' crystals there. We design the track and the mission for participants from beginners to professionals in every year. Every team can earn their success because of different hardness of targets, e.g. 8x12, 4x36, 2x72 and one 108 points.

The naquadah crystal: The crystal is 5mm in diameter, 25mm long and it's weight is 4g, a non neodym magnet. Magnets are supported by organizers.

The robot: The robot is double wheeled in this year, max size is 25x25x25 mm and mass less than 4kg. Only wheels can be used to navigate during moving and forwarding. The robot must be self powered, must use only slopes to reach the higher regions.

Mission and race: . Missions start with a drawing. The mission time is 15-20 minutes. After the first qualification round the second round is a mixed qualification, there are together the first and last teams, second and the penultimate, and so on. Points are summarized.

Control and navigation: Human commands have to be delayed for 10 seconds. The track is visible for the teams as from 2011 (because of cost limitations and it is easy to get pictures from robots nowadays). Autonomous control is available which is helped by a 'satellite' camera above the track.

The main scientific goal in 2013*:* The main scientific goal in 2013 is to learn balancing and control engineering knowledge or to involve more mathematician and physicists into design and competition. During years competitors were mainly electrical engineers and IT specialists. They should invite experts from other disciplines or should acquire knowledge described above.

Planetary research specific features: Different objects, like maze and layers will be placed on the plotting board to make the task difficult enough to move, turn, navigate, climb and reach the targets. Different scores for goals increase the significance of a better strategy. Command time delay and automatism support the independent reliable operation. In a planetary mission it is necessary to put down and populate measuring devices and to collect them back. During this process it is necessary to dodge the stones and reach a hardly available place.

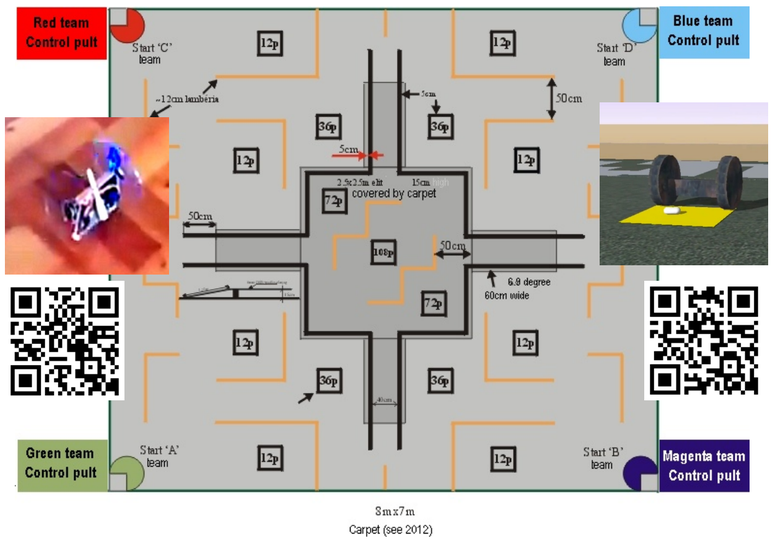

Fig 7: Plotting board track of 2013. Real model by Sipos left [10] and a virtual model by Vizi right [11]

Virtualization: Like described before, organizers make virtual traces for races already months before the date of the competition in this year also. http://magyarokamarson.hu/virtu/ [10]

Teams came form: Budapest Univ. of Technology and Economics (BME); Óbuda Univ. Kando Faculty of Electrical Engineering; Faculty of Informatics of Univ. of Debrecen (UniDeb); Computer Science Department in Károly Eszterházy; Eötvös Univ. (ELTE) Institute of Physics, Department of Material Physics, and other team members from the Dept. Informatics; Pécs Univ. - Dept. Informatics and G. Technology; Széchenyi István Technical High School, Székesfehérvár; UniNKE (former National Defense Univ, ZMNE) MSc and Doctoral School of Military Sciences etc.

Conclusion: As a summary, it can be said that competitors have to be capable of designing, developing and constructing complex robots, and moving them by driving from wheel and caterpillar (2006-2008) through amphibians (2009) and elevator climbers (2010) legs (2012) balanced double wheels (2013). During competitions a lots 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. One of them made the first independent Hungarian satellite, Masat-1 and since February 2012 Masat-1 have been orbiting the Earth.

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