

**NEW PROGRAMS WITH THE HUNVEYOR EXPERIMENTAL PLANETARY LANDER IN THE UNIVERSITIES AND HIGH SCHOOLS IN HUNGARY.** Sz. Bérczi<sup>1,2</sup>, B. Drommer<sup>2</sup>, V. Cech<sup>2</sup>, S. Hegyi<sup>3</sup>, J. Herbert<sup>4</sup>, Sz. Tóth<sup>2</sup>, T. Diósy<sup>2</sup>, F. Roskó<sup>2</sup>, T. Borbola<sup>2</sup>, <sup>1</sup>Eötvös University, Dept. Petrology, H-1088, Budapest, Muzeum krt. 4/a, Hungary, <sup>2</sup>Eötvös University, Faculty of Sci., Cosmic Mat. Sp. Res. Gr., H-1117, Budapest, Pázmány P. s. 1/a, Hungary (bercziszeni@ludens.elte.hu) <sup>3</sup>Janus Pannonius University, Dept. Appl. Math. Informatics, H-7625 Pécs, Ifjúság u. 6., (hegyis@ttk.jpte.hu), <sup>4</sup>Angster J. Sz. I. H-7624 Pécs, Rét u. 41. Hungary.

#### ABSTRACT

Our planetary lander type robot, Hunveyor (**H**ungarian **U**niversity **S**URVEYOR) [1-2] was successfully extended in university and high school education in Hungary. We report three types of developments: a) developing a stereo camera system and 3D view on a planned rover accompanying Hunveyor (example was Pathfinder), b) opening an internet possibility [3] to use Hunveyor as if it were standing on a planet, studying the main rock types of the inner Solar System, and c) beginning of lander construction by some new high school teams.

#### INTRODUCTION

On the Eötvös University, Budapest, (Dept. G. Technology) there are two levels of laboratory facilities, and courses to prepare students in robotics. The *first level* educates how a physical experiment can be planned, constructed, (signals transformed by A/D converter, etc.) and how these units can be built into a measuring system. On the *second level* there is the Hunveyor experimental lander which realizes how to build together the measuring subsystems (and also gives the possibility of harmonizing experiments, fit them together, suborder and operate them by the on board computer and telemetrics, organizes signals to be transported to the operation center).

#### NEW DEVELOPMENTS ON HUNVEYOR

Hunveyor minimal probe was constructed last year [1, 2]. Since that time the connection was established by IR signals. One group developed a 3D camera to Hunveyor. The other group constructs a rover and its connection to webpage. This page was opened for students to make possible movement operations and 3D observations, as if they were on a planetary surface.

#### ROVER MOVES, MAKES STEREO PICTURES ABOUT ROCKS

Encouraged by the success of Pathfinder a group of colleagues and students made plans and builds now a rover, which moves to and fro between rock types and makes stereo pairs of photos to measure distances. This experiment is described in another paper, here mentioned because it forms part of the operations with Hunveyor on internet [3]. Another group developed 3D camera using red and green filters, and mirror duplicated color pictures. The wireless communication was our next step in communication developments of Hunveyor. First we built an IR communication. The distance between Hunveyor lander and the main server was maximum 10-15 meter. The planned rover moves in the vicinity of Hunveyor, but not a longer distance. (Next generation will be the radio communication.)

#### BEGINNING OF PLANETARY PETROLOGY BY LANDER ON SURFACE: THE MAIN ROCK TYPES TOUCHED WITH THE ROBOT ARM BY STUDENTS

We arranged Hunveyor as if it were landed on a planetary surface and arranged around it the most important rock types from the Solar System rocky bodies. The list of rocky actors around is as follows:

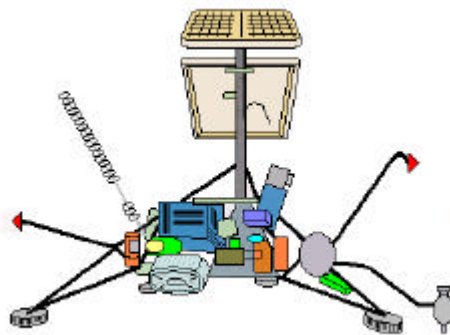
1. **basalt with mantle xenolith** (basalt is the most common rock type in the Solar System, the specimen is from Szentbékállá, Balaton highlands, W-Hungary) [4]
2. **lherzolite** (over mantle xenoliths Martian meteorites represent this rock type from the Solar System, the specimen is from Szentbékállá, W-Hungary) [4]
3. **komatiite** (it represents early volcanism on Earth, high Mg content, probably present in volcanism of Mars and Io, and found similar rock by Venera 14 on Venus, too; the specimen is from Australia) [5-7]
4. **andesite** (a rock type mostly in island arc in plate tectonics, but present on Mars recognized by Pathfinder; the specimen is from the Inner-Carpathian Arc, Börzsöny Mts. N-Hungary) [8-9]
5. **zeolite** (a rock type produced by surface weathering on Mars and also by hydrothermal volcanism and metamorphism on Earth; the specimen is from Rátka, Tokaj Mts. E-Hungary) [10-11]
6. **rhyolite by impact melting** from granite (a larger piece from Ramsö island, Mien crater, Skone Province, Sweden, which exhibits clasts and fragments from the precursor rocks) [12]
7. **gabbro** (both on the Moon and Earth it is an important mafic rock, both a microgabbro and a larger grain sized gabbro is from Tardos Mine, Szarvaskő, Bükk Mts. N-Hungary), [13]
8. **wehrlite with high titanium content** (at Szarvaskő, both some gabbros and wehrlite ore peridotite has this unusual characteristic making them relatives to the famous Apollo 11 and 17 high Ti basalts) [13]
9. **vesicular basalt** (sometimes found by Apollo astronauts on the Moon, i.e. 15016, [14] the specimen is from Ság Mt. Celldömölk, W-Hungary)
10. **granite** (we know it from the Earth in large block and as small fragments they occur on the Moon, probably Venus may have this rock type, too; the specimen is from Erdős-mecske, Mórágó r. Mecsek Mts. S-Hungary)
11. **phonolite** (Venera 13 found such high K rock type on Venus, the specimen is from Mecsek Mts. S-Hungary), [5]
12. sand from river Danube gives a homogeneous background. (later planetary simulant soils [15-16])

#### OTHER NEW INSTRUMENTS ON HUNVEYOR

There are other two new instruments on Hunveyor lander. The first is a thermometer. We use an NTK resistance to analyse the rock and the soil temperature. It is attached to the end of the arm. The other is a reflectance spectrophotometer: a type similar that we have got on the last year LPSC pre-conference. We attach it onto another robotic arm.

ATTACHED BENEFITS OF HUNVEYOR: ROBOTICS AND PLANETARY SCIENCE IN HIGH SCHOOLS

Hunveyor experimental lander is also an enthusiastic tool to teach any kind of robotics. Therefore we begin to use it in high school education, to make movements in imagination by robotics in students. The frame was made for them by one of the participating schools, and the teachers and students together developed the classical experiments onto the Hunveyor. Even elementary measurements of temperature, magnetism, wind-strength, and other meteorological parameters makes joyful task to do with on an imagined space probe, yet in terrestrial station. (This is the general conclusion from International Space Camp, successfully employed in education [17]).



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<http://drommer.elte.hu/>

Table 1. The block diagram of the construction and the subsystems of the Hunveyor experimental lander we continuously develop on Eötvös University. (It is without orbital subsystems and propulsion, but focuses on building experimental equipments, harmonizing them on board of the lander.) This works make capable teachers and students to learn to construct equipments of real missions in the future.

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