

## Test report of PicoR GPR prototype. Pavement survey. May 2013

The tests were conducted during the field experimental work on May 15-16, 2013. Survey was carried through the streets in Moscow: highway of Enthusiasts, the Free prospectus and the other.

The aim was to:

- 1) Functional test of the antenna module PicoR AM1 with a longer USB cable.
- 2) Functional test of the antenna module prototype PicoR-2 in the new housing.
- 3) Testing software enabled GPS.
- 4) Determination of the optimal speed of the vehicle.
- 5) Determination of the maximum possible depth probing for antenna modules PicoR AM1 and PicoR-2.
- 6) Evaluation of the possibility of using algorithms for automatically determine the thickness of the ice to determine the thickness of the asphalt pavement.

During the tests the following equipment was used:

- Antenna module PicoR AM1 with a USB cable length 2.5 m;
- A prototype of the antenna module PicoR-2 in the new housing with a USB cable length 2.0 m;
- External GPS-receiver which is connected via a USB extension cable length 3 m;
- PicoR software, version with support for GPS;
- Field notebook DELL Latitude 6420 ATG;
- GPR ProEx with shielded antenna 500 MHz;
- barbell-trailer for GPR ProEx;
- Honda Mobilio car with tow bar.

Tests were divided into three phases:

- 1) The test of PicoR AM1 module with a USB cable, 2.5 m long, attached to the tow bar with reinforced tape.
- 2) The test of PicoR AM1 module with a USB cable, 2.5 m long, attached to a barbell-trailer. Work was carried out in conjunction with the radar ProEx.
- 3) The test of PicoR-2 module prototype attached to the barbell-trailer. Work was carried out in conjunction with the radar ProEx.

Automatic processing, operational processing and post-processing of the data were carried out in the PicoR software.

Below there are photos made in different mounting stages.



Fig. 1. Mounting the antenna module PicoR AM1 on tow bar.



Fig. 2. Mounting the antenna module PicoR AM1 on barbell-trailer.



Fig. 3. Mounting the prototype module PicoR-2 in the new housing on the barbell-trailer with simultaneous mounting the antenna unit GPR ProEx 500 MHz

Below there are processed data obtained during field work.

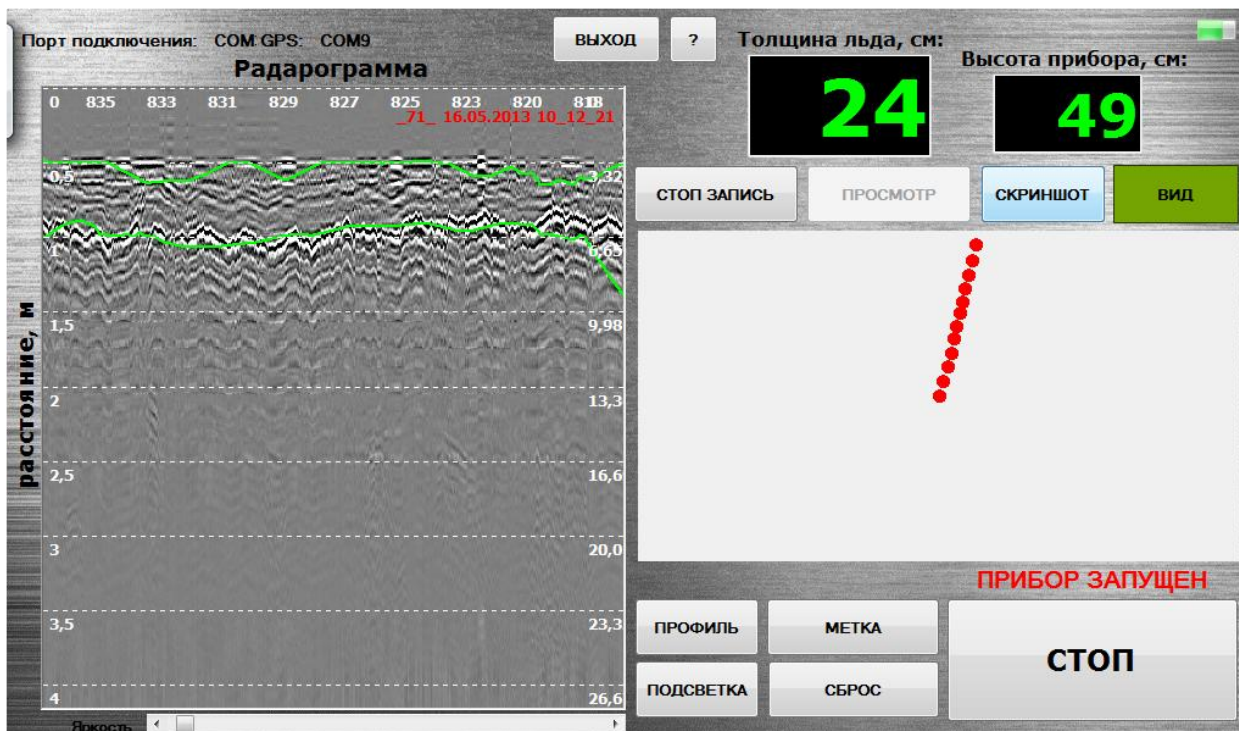


Fig. 4. An example of a stable operation of the standard algorithm for automatic selection layer of asphalt concrete pavement. The PicoR software enabled GPS. PicoR AM1 module with extended cable. Velocity of the vehicle is 37 km/h

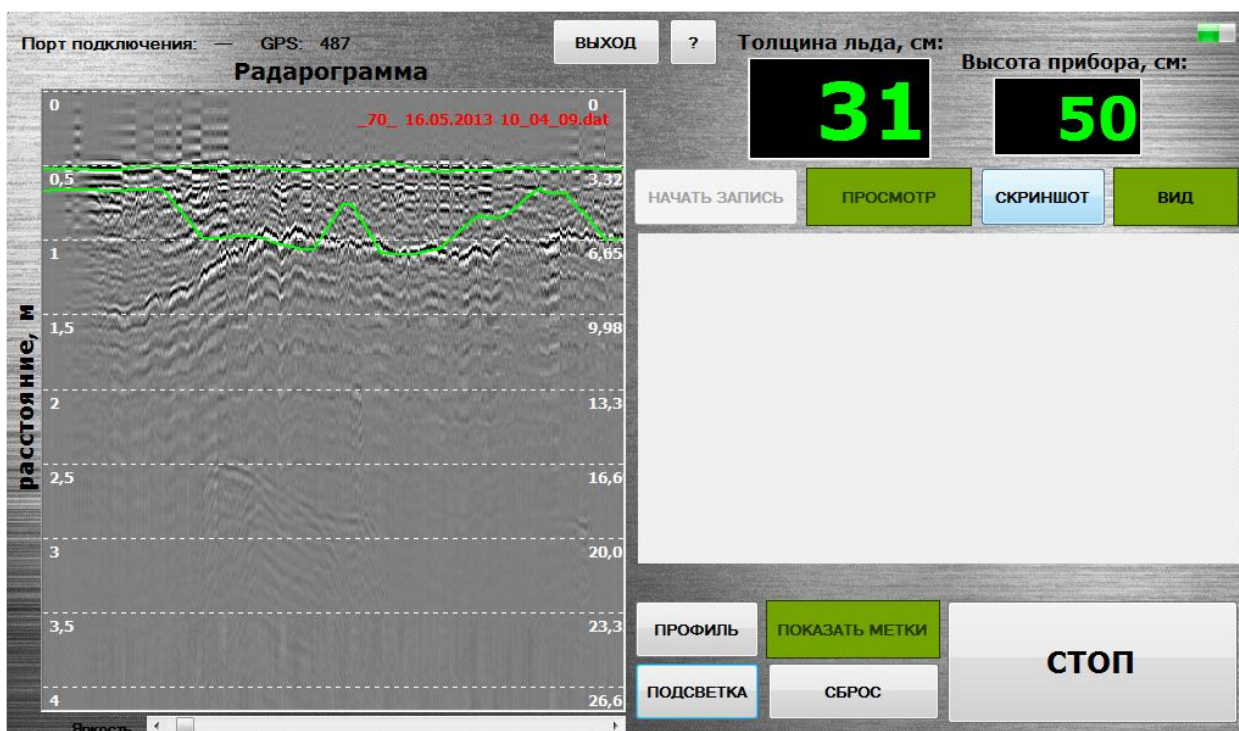


Fig. 5. An example of an unstable operation of the standard algorithm for automatic selection layer of asphalt concrete pavement with a sharp increase of coverage soles depth. The PicoR software enabled GPS. PicoR AM1 module with extended cable. Velocity of the vehicle from 25 km/h to a full stop at the traffic lights.

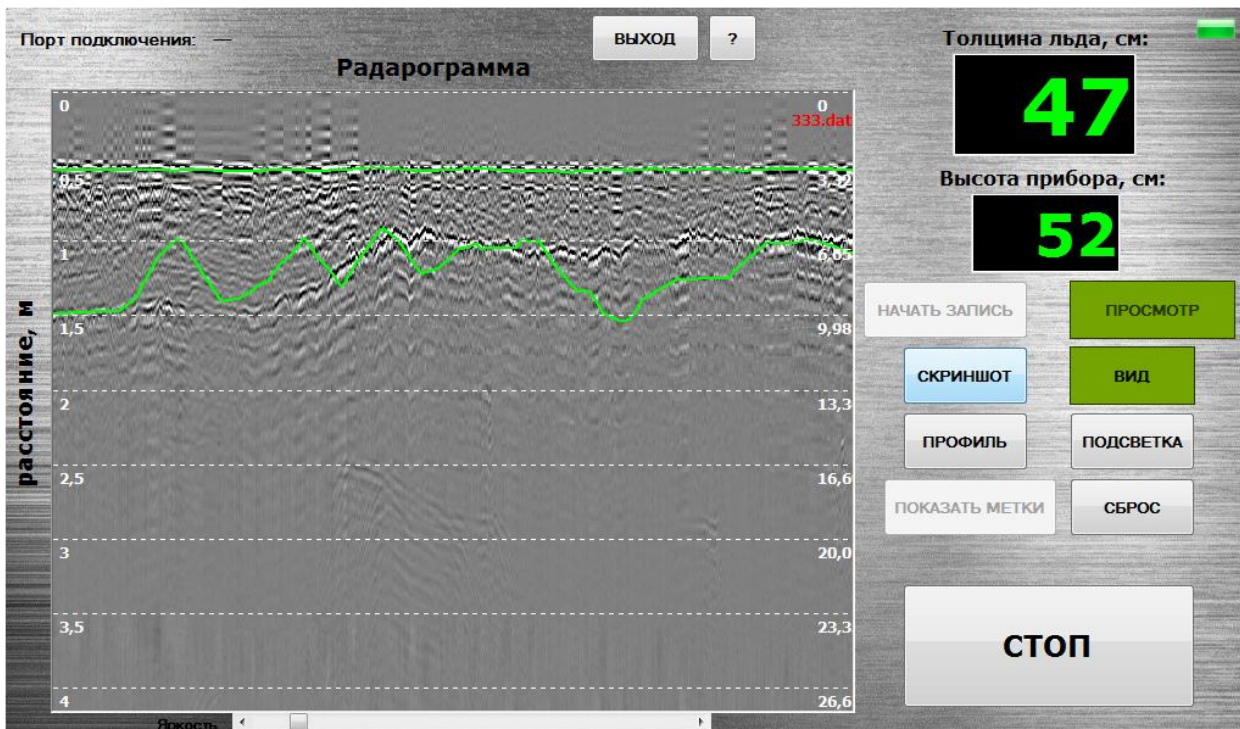


Fig. 6. An example of a quasi-stable algorithm for automatic selection layer of asphalt concrete pavement with a sharp increase of coverage depth from the base of 24 to 47 cm. Online processing. Changed parameter threshold from 5% to 2%.

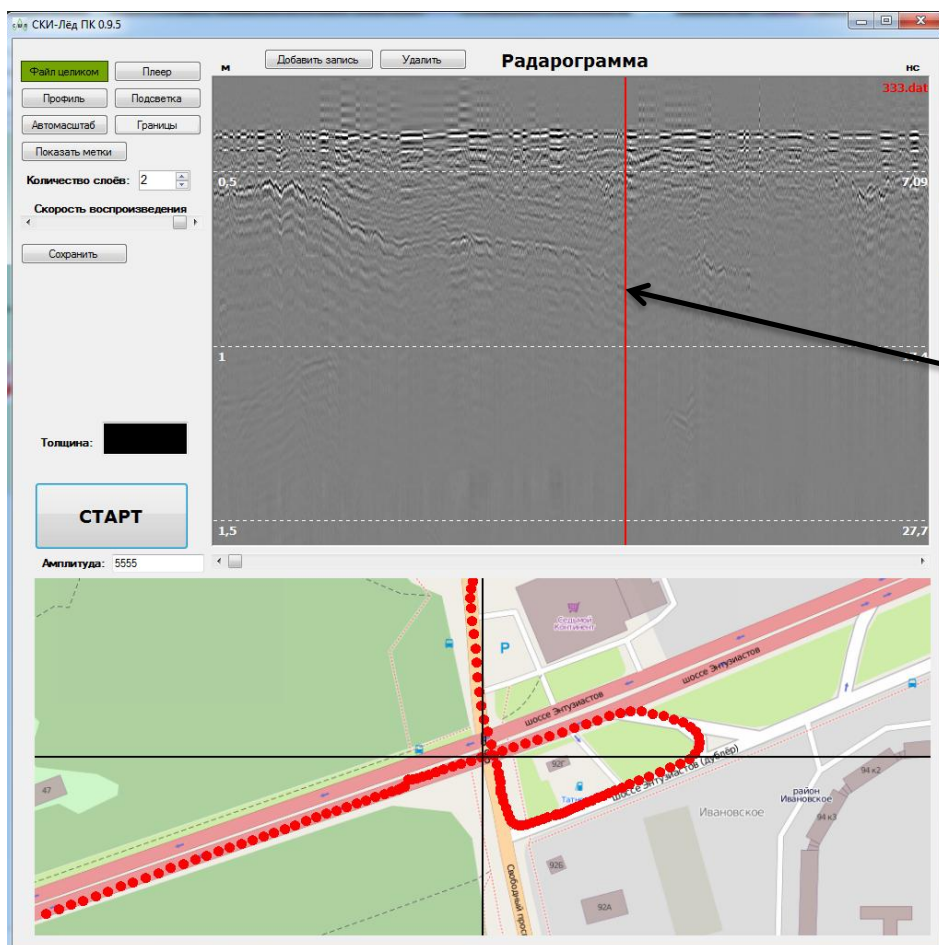


Fig. 7. An example of a recording in post-processing. Fixed thickness of the asphalt concrete pavement is 70 cm

## Results

- 1) Both antenna modules have been successfully tested and found to be unfit for work to determine the thickness of asphalt pavement.
- 2) The proximity of the metal tow bar has almost no effect on the amplitude of the reflected signal. It was recognized the possibility of developing module mounting on the tow bar in close proximity to it. Height of fixing the module above the road surface must be at least 20 cm, but not more than 50 cm.
- 3) The works were carried out at a vehicle speed of 40 km/h. Density of observations at this speed is not less than one frame at 10 cm of profile.
- 4) The thickness of the asphalt concrete pavement on the highway of Enthusiasts at the intersection with the Free prospectus increases to values of 70 cm. Using the PicoR AM1 module consistently traced the reflected signal from this depth (Fig. 7).
- 5) The standard algorithm for automatically determining the thickness of the ice works steadily at a thickness of asphalt pavement around 20-30 cm and evenness of sole covering.
- 6) In the case of more powerful coverage or frequent changes in depth to determine the thickness of the sole of the coating may be used operational or desktop modes of processing.