

## 4. SUMMARY

In order to provide near real-time data transmission of river surface velocities, a radio module was added to an existing prototype Smart Geo Particle drifter. The radio module transmitter module chosen was the Adafruit Feather M0 which uses LoRa RFM95. The communication protocol between SGP main controller which handles an IMU, GNSS and SD card modules and the radio transmitter controller were developed. Data were received with a second radio receiver module and forwarded to MATLAB processing scripts via a standard PC COM port. Based on MATLAB, a simple GUI interface was implemented which combined data processing scripts. Finally, position forecasting considering uncertain data was implemented using a Kalman filter.

The actual performance of the radio module was tested in a real-world field test at the Pirita River in Estonia with goal of evaluating performance of fully-functional prototype. During the field tests, ~400 m section of the Pirita River was mapped. Secondly, the field test was made to verify adequacy of radio transmission range.

Field tests showed reliable performance and stable radio signal given that direct line of sight is available. If large terrain obstacles exist which block the direct line of sight, the radio signal may be lost within 200-300 meters. Thus, to gather data reliably, it is required to manually follow the drifter along river. Over flat terrain with line of sight, the radio signal was able to achieve successful transmission of up to 1200 m. Thus, for coastal or marine applications, the radio-enabled drifter will likely have a larger range.

Finally, it was found that a Kalman filter can be used to forecast the drifter position considering uncertain data. This is important in cases when the radio signal is lost. However, it was found that the accuracy of the predictions was generally too low for practical applications. Positions can be predicted with high accuracy, but only in cases when the drifter moved with constant velocity and constant direction, which is rarely the case with dynamic rivers.

Future work should be carried out to increase the transmission distance and to improve position prediction accuracy when radio contact is lost.