CYSBRSNERS
High Frequency Monitoring System for Integrated Water Resources Management of Rivers

The hydrological and geochronological processes that take place in the Mediterranean basins occur at varying spatial and temporal scales. Temporary river hydrographs are flashy and exhibit characteristic response times ranging from minutes to hours so as to be experienced during first flush and storm events. When high rainfall intensities fall upon crested soil after long periods without precipitation, first flush floods occur which transfer large quantities of sediments and pollutants. The transfer of this material is short in duration, occurs under unmonitored and undefined weather conditions, and do not allow as the opportunity to study the factors that control such phenomena. The pollution passes and we are not here to measure it.

CYSBRSNERS projects we developed an integrated data collection and in-situ processing system, with adaptive/high frequency sampling capabilities without downgrading in the quality of the data collected while maintaining energy efficiency and reliability.

Fluid (River Flow) Motion Field Estimation: Statistical Analysis

- Extraction of the River Surface Velocey vector field during a flash flood event.
- Discharge calculation during the event.
- Optical Monitoring Subsystem

Results from the image/video processing methodologies of extracting surface river flow velocity for the calculation of the flood event discharge and duration.

The table below displays the results from our methodology compared with the measurements taken with a Doppler device. Our methods give an estimation of 0.014/m/s, which is a very small and acceptable deviation compared with the Doppler device’s recorded flow velocity of 0.85/m/s.

<table>
<thead>
<tr>
<th>Method</th>
<th>River Velocey</th>
<th>VI Velocey</th>
<th>LIDAR Velocey</th>
<th>SAR Velocey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler</td>
<td>0.85</td>
<td>0.57</td>
<td>0.63</td>
<td>0.67</td>
</tr>
<tr>
<td>Proposed</td>
<td>0.81</td>
<td>0.46</td>
<td>0.62</td>
<td>0.71</td>
</tr>
<tr>
<td>In-Field</td>
<td>0.82</td>
<td>0.57</td>
<td>0.61</td>
<td>0.67</td>
</tr>
<tr>
<td>Literature</td>
<td>0.85</td>
<td>0.59</td>
<td>0.63</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Flash Flood Event (First Flood)

A long-duration, interior rainfall cause flash flood event.

The Table of this material is short in duration and occurs under undefined weather conditions. For the moment, we have implemented appropriate tool and methodologies for capturing the pollution.

INNOVATION

Cybersensors is focused on the implementation of an integrated cyber-physical system incorporating new methodologies and sensors (optical, non-invasive sensors) for monitoring hydraulic parameters along with the capability of in-situ processing of the acquired data.

Monitoring complex environmental systems (such as floods in ephemeral rivers), with conventional sensors is not always a reliable method for recording the occurring processes.

For this reason, we employed optical sensors for estimating the river flow velocity vectors by calculating the river discharge, and also for estimating the concentration of suspended solids.

SENSORS

Using optical (non-invasive) sensors for quality analysis, chemical content and the frequency of sediments and river flow.

IN-SITU DATA PROCESSING

Due to the use of optical sensors, the Cybersensors system is capable of processing data in the field while maintaining high energy efficiency.

MODELING

Using models with high fidelity for predictions and visualization of information for sediment flow sensors.

HOW IT WORKS

A network in the wireless sensor network communicate with the Control Unit, which is the coordinator, receiving and controlling the nodes. The nodes collect and forward all measurements to the Control Unit for further processing which in turn, sends the processed results to a remote database.

Water Quality node

The node of the physical-chemical parameters is used for monitoring and recording of physical (supply, particulates, temperature and physical-chemical (conductivity, dissolved oxygen, nitrate, pH)) quality of the river and consists of sensors based on the principles of electrochemistry.

Camera node

It consists of an optical sensor which with the use of image/video processing algorithms determines the vehicle vector and the river discharge along with the distribution of sediments through the analysis of the color characteristics of the image that illustrates the surface flow of the river.

Suspended Solids Measuring System (Sediment Trap)

The system measures the new level level and the silt content in the river, as well as the water flow. The suspension is then proportioned to the river flow, and then calculated by the benefit of the solids in the whole discharge.

Wireless Sensor Network

CyberSensor Technical Features