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Automated high resolution image acquisition in polar regions

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As part of an IPY project aimed at the study of the hydrology of a polar glacier, we have developed an automated image acquisition system for the continuous monitoring of environmental parameters such as weather, quantitative and qualitative snow cover analysis, albedo and identification of ice and snow covered area, or water flow on the icesheet as extracted from pictures taken on site.

We present the results of pictures acquired using an automated digital camera for autonomous data acquisition in polar environments. The objective of this set of instruments – ten image sensors located on a same glacier basin in Svalbard, 78^{o}N, coupled with scalar sensors such as temperature and wind speed sensors, is to continuously monitor the physical conditions around a polar glacier. The data gathered, including the high resolution digital images, are analyzed in order to better understand the hydrology of the glacier as part of the Hydro-Sensor-FLOWS IPY project.

We have developed the electronics for automatically triggering a digital camera by simulating the action of a human operator: any digital camera, and more generally electrically controlled instrument, can thus be adapted to this method, including consumer high resolution yet affordable digital camera. Emphasis was put on energy saving since the camera are developed to operate autonomously for several months in a polar environment. Furthermore, we have focused on reducing the effect of the harsh environment on the camera by developing several packaging supposed to protect the consumer grade camera from water condensation and ice. We have selected 10 Mpixel

digital camera with high quality lenses, able to capture high quality images compatible with the requirements of automated image processing. We will present the challenges of these developments, including the storage and management of the huge number of images acquired during the first 3 months of this experiment, and justify our choice of adapting consumer grade camera to this purpose rather than developing a new sensor from scratch. A major issue concerns the storage and retrieval of the date at time at which each picture was taken for an accurate reconstruction of the environment of the glacier.

One of these sensors was located in Greenland and gathered images during 2 months at the rate of one picture every 2 hours. Beyond the qualitative analysis of the data, we have attempted various automated digital analysis algorithms in order to correlate glacier flow with environmental conditions (tide, wind speed and direction, temperature). These classical algorithms were originally applied to the monitoring of glacier motion in the French alps, using low resolution webcam images: ice flow measurements will be presented as deduced from image processing. Automated motion detection, and more generally digital image processing, justifies the need for high resolution images as will be demonstrated when comparing results extracted from webcam-quality and 10 Mpixel camera images.