CoastAdapt

Snapshot

Coastal imaging: using coastline monitoring to observe and analyse coastal processes

Summary

Coastal imaging is a camera based, remote sensing technology that provides coastal managers, engineers and scientists with accurate, near-real time measurements of coastal features and processes. Coastal imaging systems are typically deployed to remotely collect images of the coast. This can help coastal managers measure things like shoreline position, beach erosion, recovery volumes, sand bar and rip characteristics, wave and run-up processes, water depth, and beach use. Coastal imaging enables frequent and simultaneous measurement of these parameters across several kilometres of coastline and provides helpful data summaries for planning and management decisions.

Background

With the development of digital imaging and image analysis techniques, one or more automated cameras can be installed at a remote site and programmed to take photos and send them to a database via an internet connection. This growing image database, taken at regular intervals (say every half hour of the day) for periods of years, can cover up to several kilometres of a coastline from an individual station and yield very valuable information.

Not every image will be analysed in detail, but coastal managers can be confident that all 'events' will be documented and available for more detailed analysis if required. This coastal monitoring technique provides coastal managers with the ability to continuously record, document and quantify shoreline changes, with the added benefit that information can be regularly issued to the public on an automated basis if required.

Keywords

Coastal imaging, webcam, remote coastline monitoring, data collection

Table 1: Types of coastal imaging tools. Photos: © UNSW WRL.

Type of imaging	What do they do?	How are they used?
Photos (snap-shots) 	Record what the beach looks like now	Useful for characterising the beach at a particular point in time
Time-exposure (timex) 	Show average conditions over a short period of time	An ideal source of quantitative, non-subjective information on shoreline, bar and rip positions
Variance-exposure (min and max)  	Identify the minimum and maximum variance in pixel intensity	Shows beach activity, movement of beach users and shadows, as well as the location of all breaking waves during the averaging process
Time-stacks	Record the variation in pixel intensity with time along select lines or points (called pixel arrays)	Engineers can analyse the optical metrics to infer wave speed and direction, run-up, currents, water depth and other time dependent visual phenomena

Coastal imaging systems are able to collect and produce a range of quantitative and qualitative image products that can be merged and re-projected to observe and measure coastal conditions and processes at the desired viewing angle. A typical application is the re-projection of an image from oblique to plan view that emulates the acquisition of accurate satellite and ortho-imagery, but at high frequency.

The applications of coastal imaging are numerous. Coastal conditions can be automatically identified and quantified in near-real time and reported online. Coastal management strategies such as beach nourishment can be assessed. Dune erosion during heavy storm conditions and near-shore wave spectra can be analysed. Pre and post construction environmental impacts can be evaluated, along with the performance of coastal structures like breakwaters, groynes and reefs.

Coastal Imaging in Australia

The first installation of a quantitative coastal imaging station in Australia (Argus type system) was undertaken in 1996 by the Coastal Imaging Laboratory at Oregon State University with the support of the Australian Defence Force Academy (ADFA). This was part of an international network that included Australia, the USA, the Netherlands, the UK, and New Zealand. Palm Beach in Sydney, NSW, was selected because of the usual presence of multiple rip currents. The Water Research Laboratory (WRL), UNSW Australia, has since installed seven additional Argus Coastal Imaging stations in Australia.

The Narrabeen Coastal Imaging station has been collecting imagery of the beach on an hourly, and more recently half-hourly, basis since 2004. These images are now an integral component of the long-term monitoring of this location with 40 years of monthly beach measurement data now forming the longest continual data set of its kind in Australia.

At Surfers Paradise (see Figure 1) on the northern Gold Coast, an Argus Coastal Imaging station was initiated in 1999 to fulfill the monitoring needs for the Northern Gold Coast Beach Protection Strategy (NGCBPS). In the early years of its operation, this station provided near-real time monitoring of the effectiveness of a significant beach nourishment campaign at the

Figure 1: Surfers Paradise Coastal Imaging station. Photo: © UNSW WRL.

northern Gold Coast, as well as the installation of the Narrowneck artificial reef. This station operated continuously from 1999 to 2008 collecting hourly images of the beach, and has again been operational since 2014 collecting half-hourly images. During these periods the images have been analysed to provide a weekly dataset of beach width and shoreline position, as well as analysis of erosion and accretion processes.

In 2002 a series of four Coastal Imaging stations were installed by WRL to monitor the beaches of the southern Gold Coast. They were located at Kirra, Coolangatta-Greenmount (see Figure 2), Rainbow Bay-Snapper Rocks, and Duranbah (see Figure 3). This monitoring program was established to visualise, quantify and monitor the effects of the Tweed River Entrance Sand Bypassing Project (TRESBP). These stations have operated continuously since installation and now have a 15-year record of weekly shoreline position and beach width along the monitoring area.

Figure 2: Coolangatta-Greenmount Coastal Imaging station. Photo: © UNSW WRL.

Figure 3: Duranbah Coastal Imaging station. Photo: © UNSW WRL.

The data collected by the coastal imaging stations allow researchers to develop better tools and a better understanding of the response of beaches to their environmental drivers such as waves, water levels and currents. This knowledge underpins our predictions of how beaches respond to changing climatic variables, and allows for improved management of coastal climate change through more informed adaptation of coastal assets.

Coastal imaging is now recognised as a valuable tool for coastal managers to gather important data over time, evaluate management strategies and protect Australia's iconic beaches from the growing impacts of climate change.

Further reading:

For further information, visit the UNSW Water Research Laboratory's websites. All accessed 17 March 2017. Available online at:
www.ci.wrl.unsw.edu.au
www.narrabeen.wrl.unsw.edu.au
www.youtube.com/user/WaterResearchLab

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