National Centre for Instrumentation & Marine Surveillance

Langstone Harbour Inter-tidal Vegetation Classification Feasibility Study

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NRA
National Centre for Instrumentation and Marine Surveillance

National Rivers Authority
National Centre for Instrumentation
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Langstone Harbour
Inter-tidal Vegetation Classification
Feasibility Study

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Introduction

This work was initiated as a feasibility study for the classification of inter-tidal surfaces in Langstone harbour using CASI scanner imagery collected by the NRA as part of it's National Baseline survey. Previous classifications have relied on standard aerial photography interpretation techniques being applied to colour infra-red photographs of the area. This method is very time consuming and expensive. The use of automatic image processing techniques would, once proven, would offer a much more flexible, quick and cost effective method of monitoring the inter-tidal vegetation. In addition the use of more modern techniques would allow other work such as change detection and dependency analysis (ie species vs height) as well as GIS functions to be used.

Data

The CASI data used was taken on 15th June 1994 at 08:30 GMT from an altitude of 10,000 feet. The 12 channel standard baseline bandset was sensed using the 78 degree lens. The images were taken as a R&D project in between the baseline surveys. The operational parameters used to take this data are identical to those used during baseline surveys

The problem:

A map of the plant species on the inter-tidal zone of Langstone harbour is needed by the NRA to evaluate the environmental impact of sewage works in the area. Previous studies have relied on standard air photo interpretation techniques. A new study is about to be commissioned, and the feasibility of using more modern remote sensing techniques is required. The first step is to test the procedures necessary to produce a classification of inter-tidal vegetation using CASI data. The classification produced by this study does not pretend to be an accurate classification of species but is designed to prove that such a classification is possible using data, equipment, techniques and expertise already available within the NRA.

Processing Used

The data went through the following steps: geocorrection, interpretation, training and classification. These steps are detailed below:

Geocorrection

Airborne scanner data is prone to geometric distortions that make overlay of data with maps and grids difficult. The CASI system collects GPS and roll / pitch information alongside the scanner data. The CASI is one of the most advanced systems in this respect, including software to semi-automatically fit the imagery to a grid. This process was used to fit the imagery to the British National Grid, with a pixel size of 10m

Interpretation

The imagery was displayed using a number of channel combinations to reveal the different surfaces. A number of different contrast enhancements were used. The data was further explored by plotting spectral profiles through the twelve channels for specific surfaces. This allows the spectral separability of different surfaces to be evaluated.

Training

A small subset of the image was selected that included all the major vegetation classes. Areas were delineated and labelled as being typical of a particular surface these areas are known as training areas. This could only be done on the basis of image interpretation rather than ground truth, which is preferable. Statistics for the 12 channels were derived for each of the 12 training areas and checked for separability. Training areas were then adjusted to maximise the separability. Once the eight classes chosen were separable, the statistics were transferred to the whole image.

Classification

A maximum likelihood classifier was run on the total image. This uses an advanced statistical technique to compare the 12 channels of imagery to the training statistics, putting it into the closest class. In this way the classified map was produced. This method is in widespread usage throughout remote sensing, though classification methods that use texture and other contextual methods or neural networks, are beginning to be available.

Results.

The raw imagery is presented as a true colour composite and a false colour composite using one of the near infra-red channels. The classification is presented as a density slice, with a separable colour for each arbitrary class. A table of the number of pixels in each class and the derived area is presented:

Classification results table:

Note: Class names are arbitrary, based on the colour of the false colour image.

No	Name	Pixels	Metres^2	%Image
1	Green Vegetation	25089	2508900	14.62
2	Orange Vegetation	8846	884600	5.16
3	Red Vegetation	14421	1442100	8.41
4	Deep Red Vegetation	24925	2492500	14.53
5	Pale Green Vegetation	22481	2248100	13.10
6	"Sand"	409	40900	0.24
7	"Mud"	53295	5329500	31.07
8	"Water"	22080	2208000	12.87
Image total		171553	17155300	100.00

Conclusions

It is plain that the results show that classification of inter-tidal surfaces using routinely collected baseline CASI data is possible. A tiff file of the output image is enclosed original report only), others on request). The coordinates of the file are:

Top left: 466825E, 106573N
Image Size: 808 across by 973 down
Pixels size: 10m by 10m

Improvements to the classification

The next step with this work is to improve the accuracy and usefulness of the classification. The classification can be improved by the inclusion of ground truth at the training stage. This will allow a species (rather than surface) classification and will allow accuracy estimation and confusion matrices to be drawn up. The usefulness of the classification can be improved by mosicing the images together to give a complete picture of the harbours. The data exists to produce such a mosaic, but as mosaicing has been proven in different data exercises, it was not used.

The Future:

The NRA can provide more detailed CASI imagery by changing the operational parameters of the survey (height/lens etc). This will provide more detailed information that may be necessary to discriminate species mixes. In addition, the bandset could be tailored to maximise the spectral differentiation of the desired surfaces in the harbours. This would be effected by using the enhanced spectral mode of the CASI (72 spectral channels) and plotting the spectra for the desired surfaces. Spectral peaks would then be noted, and channels placed to take advantage of these peaks. If the ground truth could be taken at the same time, then the confidence in the classification is increased.

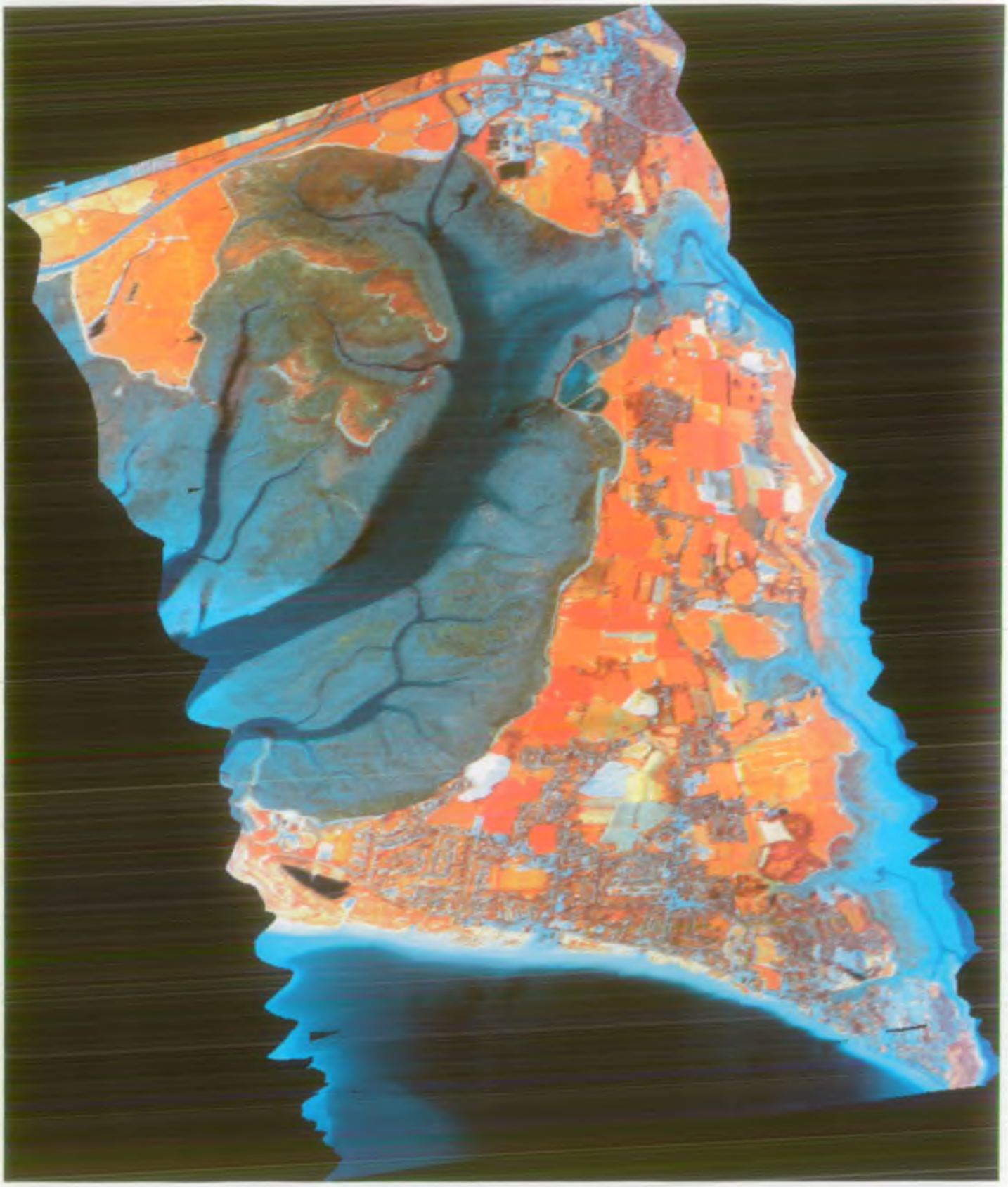
A series of images and classifications could be built up and change detection over time could be undertaken. Remote sensing techniques could be integrated with other ground based measurements in a GIS, providing a management tool for the harbour areas.

Langstone Harbour

CASI imagery taken on the 15th June 1994 at 0830 GMT.

A true colour composite image showing the red, green and blue.

Langstone Harbour

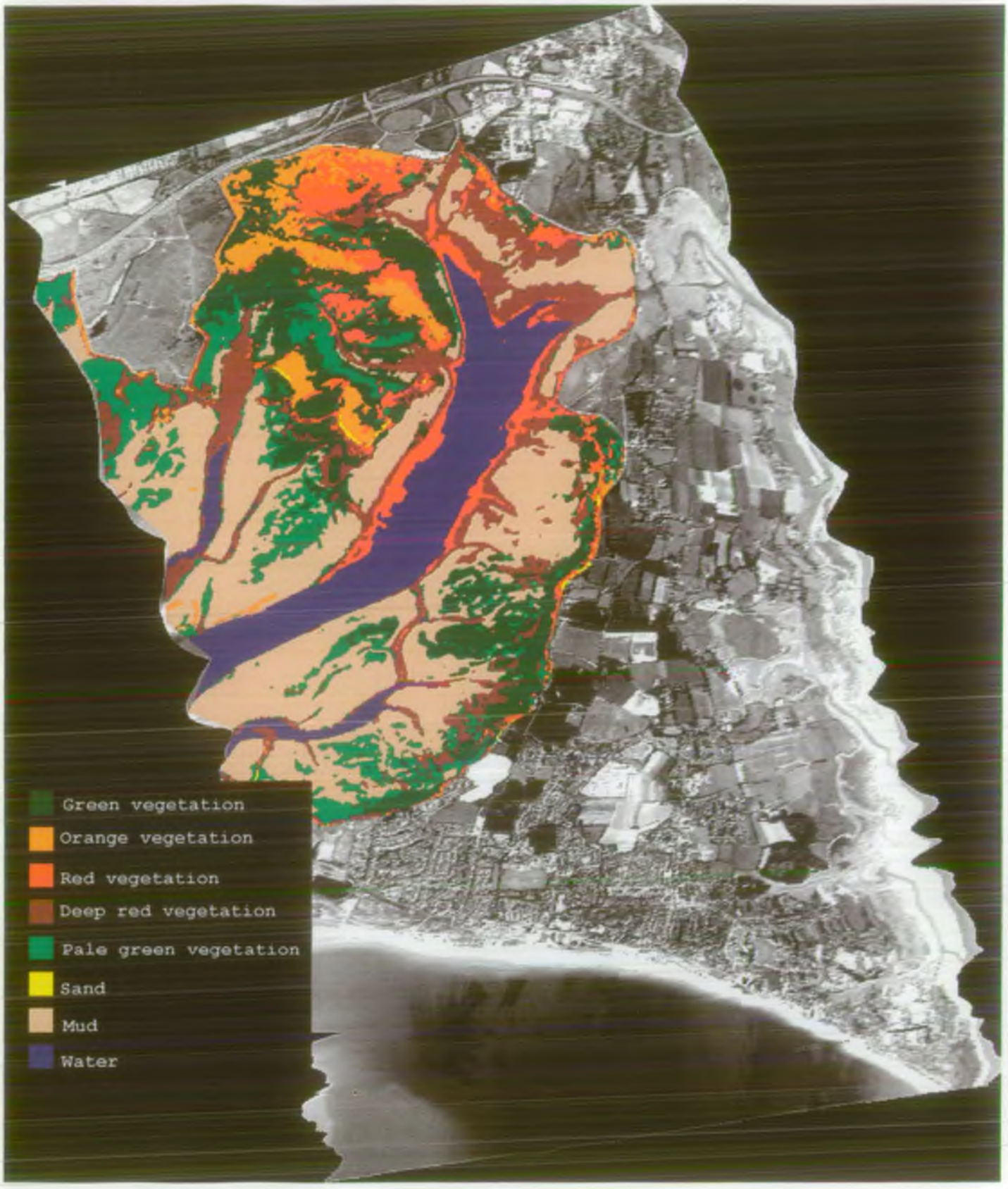


CASI imagery taken on the 15th June 1994 at 0830 GMT.

A colour composite image showing the near infra-red, green and blue.

Langstone Harbour

A classification of intertidal vegetation



CASI imagery taken on the 15th June 1994 at 0830 GMT.
Classified data overlaying a grayscale of band 7 (red).