This method should be useful for instance to remove water reverberations from OBS data without removing other seismic signals with trajectories which sometimes share the gradients.

References

A MODEL-BASED EXPANSION ON INTERPOLATION FOR MULTiresolution Sparse DATA
Ramon Reig (1), Vicenç Parisi (2), Emilio García-Ladona (3), Pere Martí Puig (1)

(1) Codesign Hw/Sw Group (UVIC), C/de la Laura, 13, 08500 Vic, Barcelona, Spain
(+34) 93 886 1222 ramon.reig@uvic.cat, Vicenc.Parsi@upc.edu, emilio@icm.csic.es
(2) AHA - DEE (UPC), Av. Víctor Balaguer s/n, 08800 Vilanova i la Geltrú, Tarragona, Spain
(3) ICM - CMIMA (CSIC), Passeig Maritim de la Barceloneta, 37-49, 08003 Barcelona, Spain

Abstract
This paper addresses the interpolation of sparse irregular data when these sparse data belong to different scales. We propose an algorithm to iteratively approximate the intermediate values between irregularly sampled data, when a set of sparse values at coarser scales is known. This is possible if there is a characterized model for the multisolution decomposition / reconstruction scheme of the dataset. Although the problem is ill-posed, and there are infinite solutions, this approach gives an easy scheme to interpolate the values of a signal using all the information available at different scales. This reconstruction method could be used as an extension on any interpolation. A simplified one-dimensional case illustrates the explanation; the scheme is based on a fast dyadic wavelet transform and its inversion, using a filter bank analysis/synthesis implementation for the wavelet transforms model. This can be a basis method suitable for applied cases where there are sparse measures from different instruments that are sensing the same scene simultaneously with several resolutions. Extensions of the method to sparse multisolution data with higher dimensions (images or vector fields) also offer some promising preliminary results.

1. Introduction
In many signal processing applications it is necessary to reconstruct a signal from a set of sparse data, [1]-[3] to name a few. Many approaches have been used for sparse data interpolation, from the popular polynomial methods or splines, to other transform-based approaches such as zero padding, wavelet transform methods [4], regularization methods like WIPE or CLEAN deconvolution [5]. All these methods either make some assumption or put some restrictions on the data. This paper addresses the interpolation of multisolution sparse, without any restriction on sparsity distribution of known data, and any condition on gaps, sizes or their distribution. Initially a filter model for the generation of multisolution data and their synthesis counterpart is the main requisite, although finally this assumption can be partially relaxed, needing only the low pass component. To fix intuitively one possible application of the method we can take a remote sensing application in oceanography, and suppose we have a set of discrete measures (i.e. sea surface temperature, SST) obtained simultaneously by processing the obtained data from several instruments on different platforms (i.e. airborne, orbital). These datasets will have different spatial resolutions, and the occlusions (i.e. due to atmospheric factors, i.e clouds) will produce gaps between the discrete values. We would like a method to calculate, using these heterogeneous and discrete measures, the best match to the “real” SST map at the highest resolution that can be achieved by these sensors. Our approach takes advantage of an initial interpolation and a second step that iteratively refines the result, minimizing the error at the coarser scales. The method is an extension of the wavelet based reconstruction of nonuniformly sampled data in [6] to a multisolution sparse data set. The zero crossings and the modulus maxima values of the wavelet transforms to reconstruct signals [7], or the edges on images, are also necessary references to our approach. The main difference is that, in our case, sparse data are in the ‘data’ domain at different resolutions, the low-pass components of the wavelet decomposition, opposed to [7], where sparse data are in the ‘transform’ domain. This difference makes our approach a priori more suitable for the cases when we have measures from instruments working simultaneously at different resolutions.

2. Results and Discussion
We represent our initial multisolution sparse data, derived from a discrete vector in Fig. 1, where sparse multisolution values are circles, and with less than 10% of the data at each dyadic wavelet decomposition level.
In Fig. 2 we have the reconstruction using a CLEAN interpolation as a first guess, and with 15 iterations on our iterative model-based multiresolution approach. We measured a Normalized Absolute Error, \[ NAE = \frac{1}{N} \sum_{n=1}^{N} |v_n - \hat{v}_n|, \] (1)

In Fig. 2 we obtained a NAE ≤ 3•10^{-2}. It must be pointed out that this quantitative result remains similar with other kinds of initial interpolation, linear, cubic or splines, but qualitative results are better with an initial CLEAN interpolation, due to the long gap on the values from sample n. 95 to sample n. 180.

3. Conclusions

We have presented an extension of any interpolation method with a dyadic and sparse multiresolution dataset, with heterogeneous distribution of sparse data at different resolutions. We made a recent extension to a sparse multiresolution image dataset and a vector-field dataset for their reconstruction, and preliminary results are very interesting. Further research should be the tuning of this methodology to sensed data from applications, especially on the design of the model for the analysis and synthesis schema for the multiresolution decomposition given a sparse multiresolution dataset.

4. References


SATELLITE IMAGE GEOREGISTRATION FROM COAST-LINE CODIFICATION

Ramon Reig (1), Vicenç Parisi (2), Emilio García-Ladona (3), Pere Martí Puig (1)

(1) Codesign Hw/Sw Group (UVIC), C/de la Laura, 13, 08500 Vic, Barcelona, Spain (+34)938861222 ramon.reig@uvic.cat, Vicenc.Parisi@upc.edu, emilio@icm.csic.es
(2)AHA -DEE (UPC), Av. Victor Balaguer s/n, 08800 Vilanova i la Geltrú, Tarragona, Spain
(3)ICM -CMIMA (CSIC), Passeig Maritim de la Barceloneta, 37-49, 08003 Barcelona, Spain

Abstract

This paper presents a contour-based approach for automatic image registration in satellite oceanography. Accurate image georegistration is an essential step to increase the effectiveness of all the image processing methods that aggregate information from different sources, i.e. applying data fusion techniques. In our approach the images description is based on main contours extracted from coast-line. Each contour is codified by a modified chain-code, and the result is a discrete value sequence. The classical registration techniques were area-based, and the registration was done in a 2D domain (spatial and/or transformed); this approach is feature-based, and the registration is done in a 1D domain (discrete sequences). This new technique improves the registration results. It allows the registration of multimodal images, and the registration when there are occlusions and gaps in the images (i.e. due to clouds), or the registration on images with moderate perspective changes. Finally, it has to be pointed out that the proposed contour-matching technique assumes that a reference image, containing the coastlines of the input image geographical area, is available.