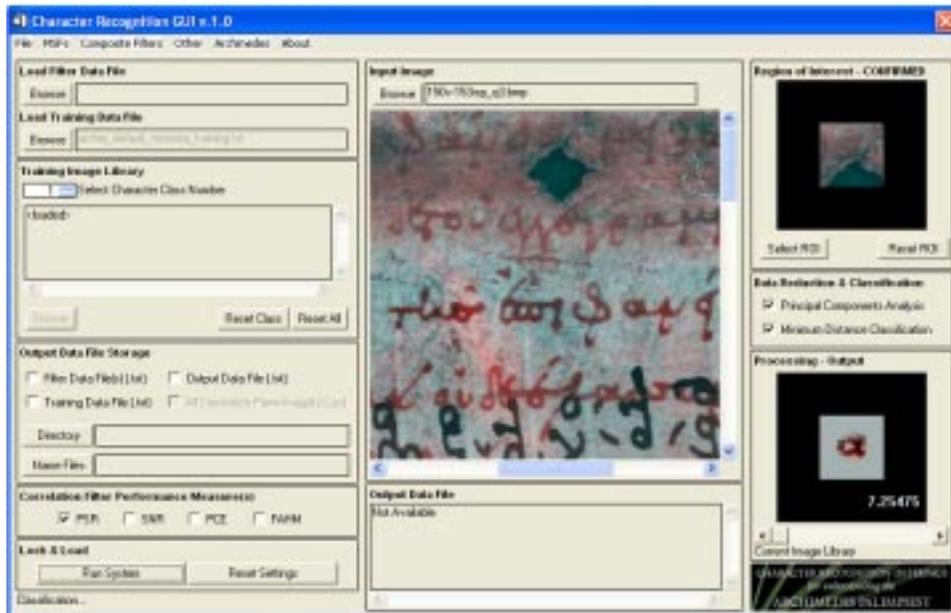


## Archimedes Palimpsest Character Recognition



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## ABSTRACT

The Archimedes Palimpsest Project has concluded, through years of scientific investigation, that a tool designed for character recognition purposes may prove useful in translating the ancient document. Developing a tool that can aid in this task is the primary objective in the research presented.

A graphical user interface (GUI) for character recognition has been developed in the IDL™ programming language. The interface allows the user to input training image data and a background image (for region-of-interest selection) into a pattern recognition system that uses several matching schemes in parallel or in conjunction to obtain features for classification. These methods include correlation filters, based on a single view of the reference, composite filter designs, based on multiple views of the reference, and other related techniques. The following is a list of the library of algorithms currently available for feature extraction: matched spatial filter (MSF), phase-only matched filter (POMF), binary phase-only matched filter (BPOMF), symmetric phase-only matched filter (SPOMF), locally nonlinear matched filter (LNMF), complement MSF, synthetic discriminant function (SDF) filter, minimum average correlation energy (MACE) filter, maximum average correlation energy (MACH) filter, and Fourier-Mellin Invariant (FMI) descriptor matching. Performance measures such as the commonly used peak-to-sidelobe ratio (PSR) are computed for each output correlation surface, and principal components analysis (PCA) is used to reduce the data dimensionality. Each class of training data is then assigned a likelihood value based on its dot product with the region-of-interest autocorrelation values.

## **MATHEMATICAL BACKGROUND**

In image classification, features can be extracted by computing selected performance measures after spatial matched filtering. Matched Spatial Filters (MSFs) used in this fashion are typically used in decision-theoretical approaches based on discriminant functions that attempt to assign sets of pattern descriptors to their individual classes. This section provides a mathematical foundation of classical spatial matched filtering processes, composite filter design, and of other related matching techniques.

### ***Matched Spatial Filters***

There are seven different MSFs included in the current version of CR\_GUI.

Ideal MSF

Crosscorrelation

Phase-Only Matched Filter

Binary Phase-Only Matched Filter

Symmetric Phase-Only Matched Filter

Locally Nonlinear Matched Filter

Complement MSF

### ***Composite Filter Design***

Synthetic Discriminant Filter Functions

Minimum Average Correlation Energy Filter

Maximum Average Correlation Height Filter

Polynomial Coefficient Filter Extension PCF-MACH

### ***Matching via Fourier-Mellin Invariant Descriptors***

#### ***Performance Measures***

#### ***Principal Components Analysis and Classification***

## **ADVANTAGES OF THIS CHARACTER RECOGNITION METHOD**

- Almost instantaneous results. Once the necessary parameters are confirmed, ie. the training image data, the bifolio image, and the recognition schemes are chosen, the user can search the bifolio image for “difficult” characters and obtain information on the likelihood of which character is present within about 30 seconds.
- Any other character recognition techniques that may be useful for this task can be easily added to this system to be run individually or in conjunction with the default techniques included.
- The input training data can easily be adjusted to minimize the number of classes thus providing an easier discrimination task. For example, if the region of interest is known to be an uppercase character, a training data file that includes only uppercase training images can be input into the system.
- Many of the techniques are shift-invariant. If the region-of-interest section contains the unknown character in the approximate center of the window, the system will run properly.
- There are no disadvantages to this system. The tool can be made more powerful by increasing its efficiency through the inclusion of better matching techniques.

## APPENDIX

Shown below are several examples of how I used the developed interface in transcribing the text of Archimedes.

