

## Apply It.



### The Math behind DIGITAL FACE RECOGNITION

Math that's used for computer-aided face recognition:

Mathematical modeling, invariant theory, algorithms

Uses and Applications:

FBI's most wanted, criminal apprehension, high profile security

How it works:

To begin with, a recognition system has to be unaffected by both external changes, like environmental light, and the person's position and distance from the camera, and internal variations, like facial expression, aging, and makeup. Because most commercial applications use large databases of faces, recognition systems have to be computationally efficient. This is where math comes into play. Most face recognition algorithms fall into one of two main groups: feature-based and image-based algorithms. Feature-based methods explore a set of geometric features, such as the distance between the eyes or the size of the eyes, and use these measures to represent the given face. These features are computed using simple correlation filters, and are somewhat immune to changes in light sources, and camera position. However, they are sensitive to aging and facial expressions. Image-based systems, the other main approach to face recognition, are based on ideas like eigenfaces, which are a related set of facial characteristics that a computer uses to recognize a person's face. Faces actually vary according to a mere 100 factors. The computer must understand what these 100 factors are. Each face image is deconstructed into separate set of related facial characteristics and an algorithm is created so that the computer can understand the image and analyze it in comparison to others.

Interesting Fact:

During the 2001 Super Bowl in Tampa, Florida the city used face recognition technology to scan the faces of people in crowds, comparing them with images in a database of digital mug shots. For more information see:

<http://www.wordspy.com/words/eigenface.asp> ; Evan I. Schwartz, "A face of one's own," Discover;

<http://www.epic.org/privacy/facerecognition/default.html>