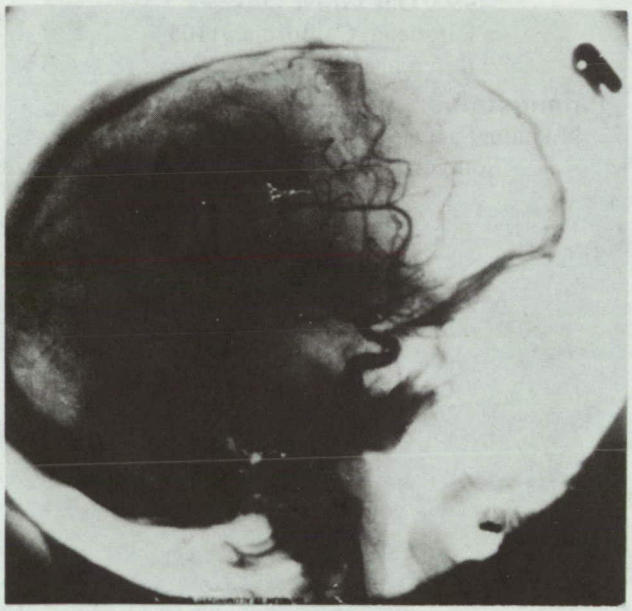
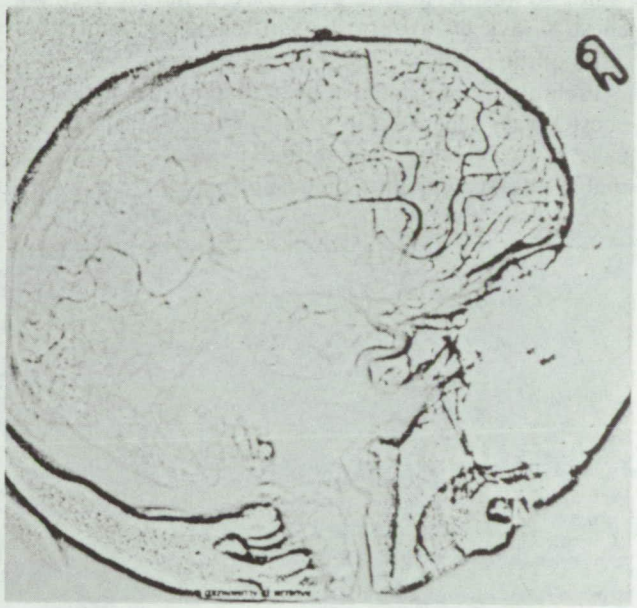
January 1967

Brief 67-10005

NASA TECH BRIEF

Digital Computer Processing of X-Ray Photos





The problem:

The interpretation of medical and biological pictures such as X-ray photographs could be made easier if selected portions of the image were first enhanced by means of a digital computer.

The solution:

For a number of years, digital computers have been used at Jet Propulsion Laboratory to correct various photometric, geometric, and frequency response distortions in the pictures received from the television cameras of the Ranger, Mariner, and Surveyor spacecraft. These methods have now been applied to the study of medical and biological photographs.

How it's done:

The first step in the process is to convert the picture into a form suitable for input to the computer. This is accomplished by means of a cathode-ray tube device that scans the film with a light beam on a line-by-line basis and converts each point of the picture to a number proportional to the film optical density. Each sample (typically 500,000 samples for a 1-in.-sq. transparency) is recorded on magnetic tape which is subsequently fed into a computer.

One of the principal methods of computer enhancement involves the use of a two-dimensional digital filter to modify the frequency spectrum of the picture.

(continued overleaf)

This filtering, in one case, is used to restore high-frequency losses (loss of fine detail) which result from the use of fluorescent X-ray intensifying screens. In other cases, the filtering is used to deliberately distort the frequency spectrum to bring out specific types of information. The figure on the left shows the sharpening of the image of a skull angiogram, and the figure on the right shows a distortion of the image which brought out the blood vessels in the front of the skull.

Another computer processing method is image subtraction. Two pictures of the same location of the body, perhaps taken at different times are subtracted from one another on a point-by-point basis. The resultant difference picture will tend to emphasize changes such as tumor growth. Subtraction is currently accomplished by optical methods but it is generally not applicable unless the areas photographed are rigid, such as the skull. The computer, however, is not so restricted and can force a match even on chest X-rays by arbitrarily shifting around different parts of the picture.

Preliminary efforts have been made using a pair of chest X-rays separated in time by six months. The rib cage of one picture was shifted by the computer to match the second and then subtracted. The results are sufficiently encouraging, but these results are not yet at a clinically useful stage.

In addition to medical X-ray photographs these methods have been applied to infrared photographs, photomicrograph scintillation, scanner displays, and standard light photographs.

Notes:

1. Further research is being conducted in this area at the Jet Propulsion Laboratory. In particular, emphasis is being placed on enhancement of pictures with specific medical value.
2. This innovation is the subject of Jet Propulsion Laboratory Technical Report No. 32-1028 and 32-877.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Jet Propulsion Laboratory
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: B67-10005

Patent status:

No patent action is contemplated by NASA.

Source: Dr. Robert Nathan and R. H. Selzer (JPL-792)