

Identification by Hand Radiographs of Children

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Introduction

Hand radiographs are used routinely to determine the “physiological age” of children. The bone morphology changes in a characteristic manner as the child matures from birth to the age of approx. 19 years. However, handling of radiographs is prone to errors: films are occasionally mislabeled, films can be misidentified during scanning, or an image of the right hand may inadvertently be used instead of a left hand. Therefore a mechanism to eliminate these errors is desired.

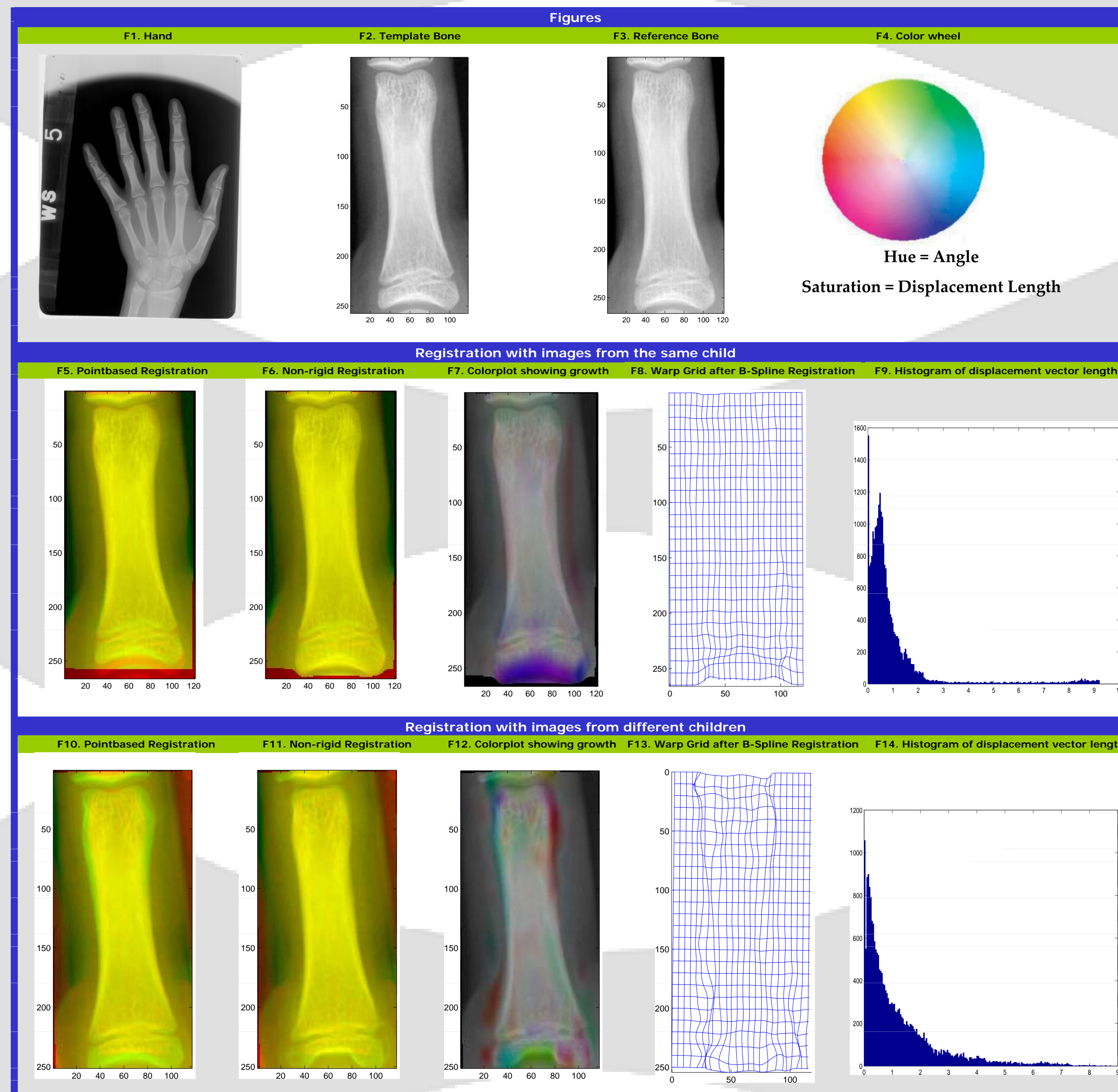
Data

Several large studies have been performed where series of hand radiographs taken with 1-year intervals have been collected.

These data allow a detailed study of the changes from year to year.

The data subjects have the age range 2-18 years. Most of the images were available as films, which were digitized using a UMAX Powerlook 1100 scanner in 300 dpi, and reduced to 150 dpi and 8 bits per pixel (an example is depicted in figure F1).

By means of active appearance models, a top (distal) and bottom (proximal) point of every bone in the images have been found with an accuracy of approx 1 mm. or better.



Method

In order to compare the bone structure in two images taken at an interval of approx. one year (F2 & F3), a very accurate registration of the individual bones in the two images is needed.

Since we know, from various medical journals, that a bone grows in a linear rigid manner, except for a growth region located in the proximal end of the bone, a pointbased registration with emphasis on matching the distal points is done (F5).

Then a non-rigid registration using B-Splines is applied in order to carry out the non-linear growth (F6).

Statistics

As shown in the histogram (F9), the warping distances seem to follow a χ^2 distribution. By use of this knowledge, we find the significant growth areas.

Score

Once the registration is complete, we use the displacement vectors to discover the growth areas (F7). If these areas correspond to the areas where growth is expected, we examine the texture in the top of the bone (where we don't expect the bone texture to change). If this area conforms to the reference area it is concluded that the two bones descend from the same person.