Automatic Derivation of Scan Plane Angles along the Vertebral Column of the Human Spine

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Abstract: Plane prescription along the vertebral column presents a tedious and potentially error prone manual task, particularly when planning MSMA (multi-slice, multi-angle) acquisitions. Various automatic approaches have been proposed as a solution to this challenge [1,2,3]. This paper presents a methodology for automated planning of oblique axial MRI scans along the vertebral column using a combined disk & vertebra search algorithm. Cervical, thoracic and lumbar examinations are considered. A validation study comparing specific angulations made by a radiologist demonstrates the robustness of the proposed method.
Process:Our database of MRI spine images consisted of 38 T2 FRFSE sagittal scans: 12 cervical, 10 thoracic and 16 of the lumbar region. Our approach was tested a variety of GE MR platforms (DV750, HDe, HD450, and HD450w) , both 1.5T and 3T.

Methods: In our method the
initially located through a
operations that utilize the
gradients exist at
This is followed by a template
for vertebra signatures, this
candidates and also reduce
morphological methods.
detected disks are computed
analysis of the identified
disks are taken as the axial
these disks.

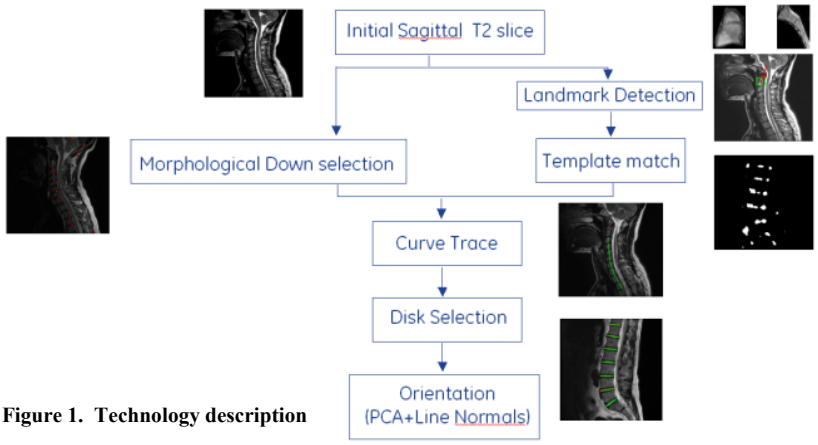

Figure 1. Technology description

potential disk candidates are
series of morphological
anatomical fact that image
bone/intervertebral disk interface.
matching procedure which looks
aims to generate additional
false positives generated by
Finally, the orientations of the
(via a principal component
object), the major axes of these
planes (in 3D) corresponding to

Results: We compared the
computed disk angulations
produced by an experienced
these results quantitatively
planes are marked in red,
are marked in green. Picture
indicator for angulation variations (to assist in interpreting the quantitative results of Table 1, while figure 4 visually depicts manual vs. automatic planning.

results of our automatically
with ground truth markings
radiologist, Table one illustrates
Visually, algorithmically defined
while manually specified planes
2 and 3 provide a reference

Figure 4: Visual comparison of algorithmic plane placement with ground truth

Region	Angulation Difference (GT vs Algorithm)
Cervical (12 Cases)	4.1°
Thoracic (10 Cases)	2.6°
Lumbar (16 Cases)	4.17°

Table 1: Quantitative Results on Population

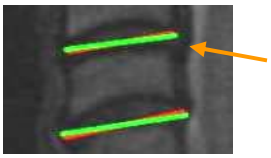

Figure 2: 5 degree variation

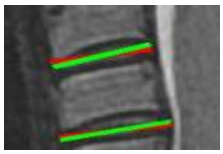

Figure 3: 8 degree variation

Conclusions: In this work, a methodology for automated planning of oblique axial MRI scans along the vertebral column is presented. The validation was done comparing angulations computed automatically by the algorithm with those made by a radiologist. In all sections of spine considered, the average angulation difference was less than 5 degrees, thus demonstrating the robustness of the proposed method.

References:

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