

AI-Based Registration of IOS and CBCT with High Artifact Expression

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KU LEUVEN



3rd DDS Global Congress 2023:
 HUMAN AND AI IN DIGITAL DENTISTRY

October 12th -14th, 2023

Hyatt Regency Hotel, Casablanca (Morocco)



Abstract

Objectives: To assess time efficiency, accuracy and consistency of automated registration between intra-oral scan (IOS) and CBCT with high artifact expression for integrated hard and soft tissue modelling.
Methods: Thirty CBCT & IOS scans of jaws with at least six teeth and four artifact sources (metallic or zirconia crowns on natural teeth or implants) in each arch were used in this study. CBCT acquisitions were performed by separating cheek and teeth from gingiva with cotton rolls. Surface-based registration of IOS and CBCT was done by two methods: 1. Semi-automatically (SR; DTX Nobel-Biocare, Switzerland) and 2. Fully-automated (AR; RELU cloud platform, Belgium)¹⁻². Registration time of each method was recorded in seconds. Registration accuracy was assessed quantitatively (3Matic, Materialise, Belgium) and subjectively by two experts evaluating IOS alignment of soft and hard tissue on CBCT. Finally, 6 IOS-CBCT scans evaluated the consistency of the registration methods.
Results: AR was 3.5x more time-efficient than SR. For accuracy, AR showed a low value of median surface deviation (0.04±0.03mm) and a high percentage of perfect matching (90%) of teeth and gingiva on CBCT in comparison to SR (59%). Furthermore, 80% of scans registered by SR needed manual adjustments. Additionally, intra-class correlation coefficient (ICC) time consistency values for AR and SR were excellent (ICC=0.99) and good (ICC=0.87), respectively. Finally, AR revealed zero surface alterations, indicating 100% consistency and SR showed 97% consistency.
Conclusion: AI-based registration of IOS and high artifact expression CBCT images is reliable; it turns out to be more time-efficient, expert-level accurate, and highly consistent.

Materials & Methods

Dataset



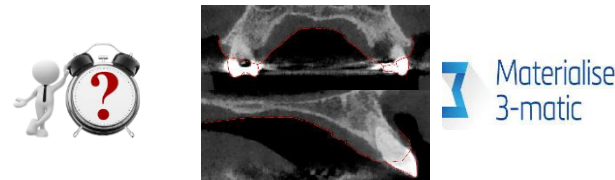
30 CBCT & IOS jaw scans & ≥ six teeth and four artifact sources (metallic or zirconia crowns on natural teeth or implants).
 CBCT acquisitions were performed by separating cheek and teeth from gingiva with cotton rolls.

Methods of registration



Semi-automatic vs AI-automated

Evaluation



Time efficiency vs Hard & soft tissue alignment vs Surface-based analysis

Consistency

Consistency of registration methods by **6 IOS-CBCT** scans.

Results

Registration time

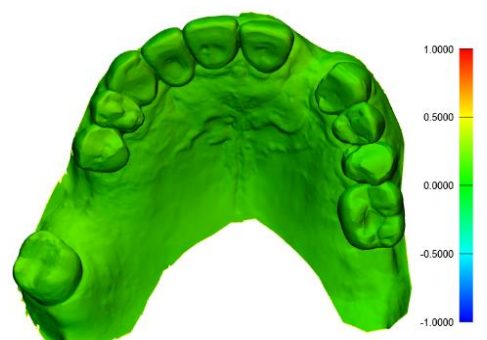
AI **3.5x** faster than semi-auto

Registration accuracy

Subjective assessment

AI showed perfect matching (**90%**) of teeth and gingiva on CBCT in comparison to SR (**59%**)

Quantitative assessment



AI & Semi-auto

median surface deviation = **0.04±0.03mm**

Consistency

AI

ICC=**0.99** & **0%** surface changes

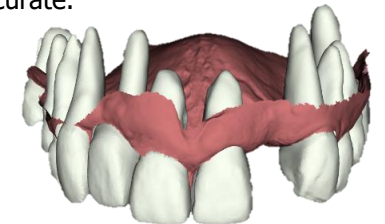
Semi-auto

ICC=**0.87** & **3%** surface changes

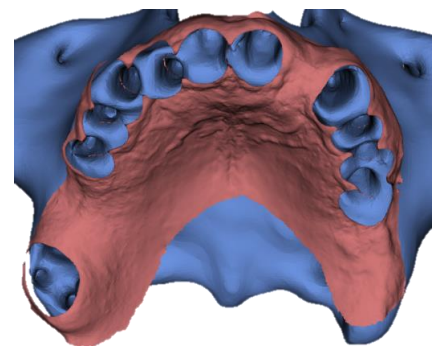


Conclusion

AI-based registration of IOS and high artifact expression CBCT images is reliable, efficient and accurate.

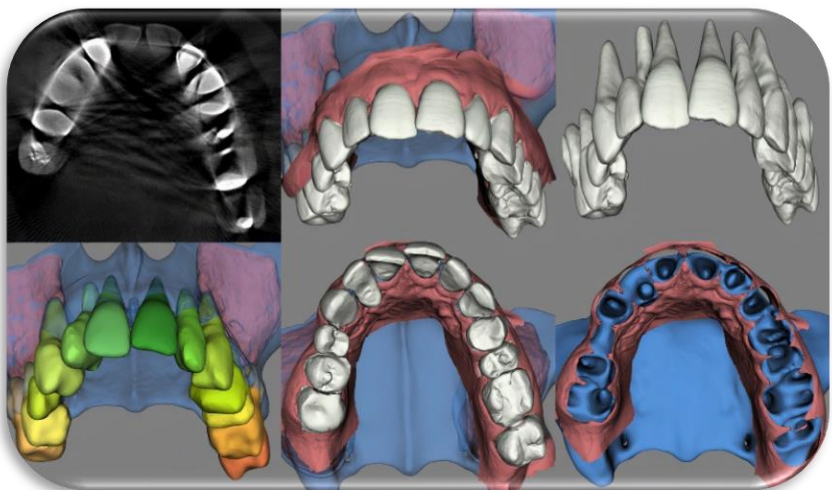


AI-based fusion of crowns from IOS and CBCT while roots from CBCT.



Oral mucosa relation to the underlying bone after virtual teeth extraction.

References



AI-based registration of maxillary jaw between IOS and CBCT with high artifact expression.