

Self-supervised context-aware Covid-19 document exploration through atlas grounding

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Annotating and systematizing the increasing quantity of COVID-19 articles requires the expertise of physicians, and is cost-prohibitive. We focus on grounding such articles from the CORD-19 dataset (Wang et al., 2020) to locations in a 3D model of the human body, where the physical proximity of objects tends to reflect their semantic relatedness, allowing for a visual navigation. In a self-supervised manner, we use a mixture of organ term occurrences within a sentence as the indication of what the sentence denotes. A reference location for medical terms of interest is obtained from a 3D atlas of human anatomy based on the Visible Human male¹ and the Segmented Inner Organs² (Pommert et al., 2001; Höhne et al., 2001). To learn a context dependent grounding, we stochastically mask the organ related terms in a sentence during training and predict the coordinates within the human body. The loss represents the average of the Soft-min weighted distances between the prediction and the organ points, which emphasizes the most nearby target locations. We use BIOBERT (Lee et al., 2019) as our model, and obtain the results in Table 1, where *Regular* and *Masked* denote grounding of the regular sentences and sentences where all organ related words are substituted with a [MASK] token respectively, forcing the model to rely solely on the context. This indicates that the model is suitable for document exploration and retrieval through the 3D human atlas.

When performing text retrieval in the physical space, we can make a query by specifying a desired location in the human atlas, and directly observe the relationship between the embedded texts in a intuitive way. We build a tool (Fig. 1, Right) where

*Equal contribution. Supported by KU Leuven Internal Funds (MACCHINA) and the Flemish Government under the Onderzoeksprogramma Artificiële Intelligentie (AI) Vlaanderen programme.

¹www.nlm.nih.gov/research/visible/

²www.voxel-man.com

Method	Regular	Masked
Center	10.77 ± 0.10	10.77 ± 0.10
Frequency	9.49 ± 0.15	9.49 ± 0.15
BIOBERT (ours)	0.21 ± 0.02	2.92 ± 0.08

Table 1: Distance to the nearest voxel of the correct organ (in cm). Center - Predicts the center of the atlas, Frequency - Predicts the center of most frequent organ.

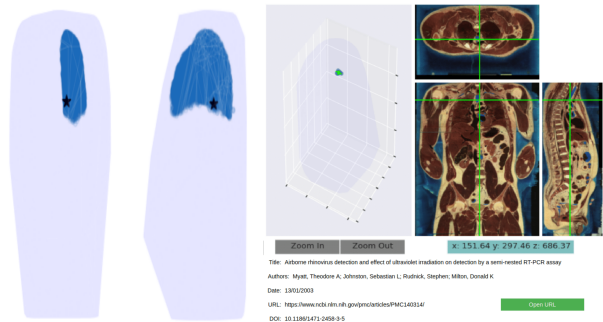


Figure 1: **Left:** Implicit lung reference grounding. **Right:** Point-cloud corpus visualization tool.

the 3D location is queried by a combination of 2D point selections on orthogonal cross-sections, while the nearest articles' 3D embeddings are shown on the left panel, where the user can zoom in and navigate between the closest suggestions. The tools and the code can be accessed at <https://github.com/gorjanradevski/macchina/>.

References

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