Hyperspectral Image Segmentation

A Preliminary Study on the Oral and Dental Spectral Image Database (ODSI-DB)

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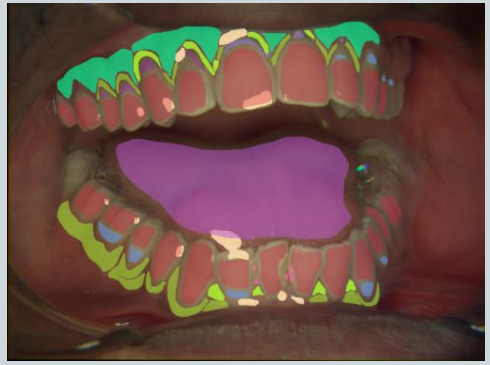
Motivation & Problem

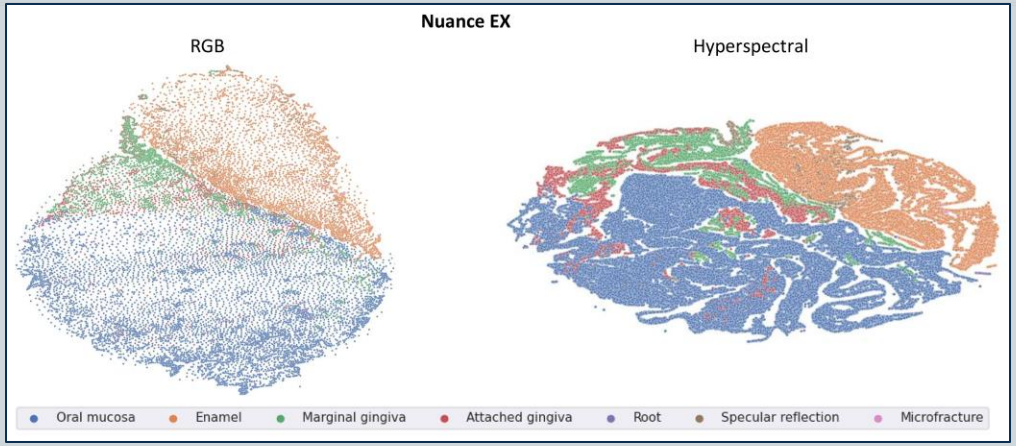
- **In dentistry, RGB imaging serves a multitude of purposes**, to name a few:
  - Patient instruction and motivation
  - Medico-legal reasons
  - Treatment planning
  - Liaison with dental laboratory
  - Assessment of baseline situation
  - Progress monitoring

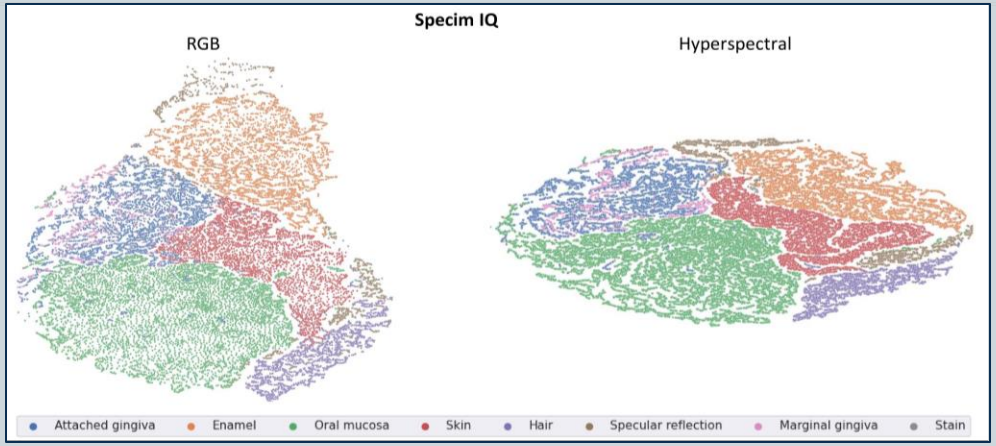


- **Hyperspectral imaging (HSI)** cameras capture more information than RGB
- There may be **perceivable differences in the reflectance spectrum of diseased tissue** compared to that of healthy anatomy
- **A preliminary step** to the development of quantitative dental and oral biomarkers **is to segment the different anatomical structures** accurately
- **Can obtain an improved segmentations with HSI?**

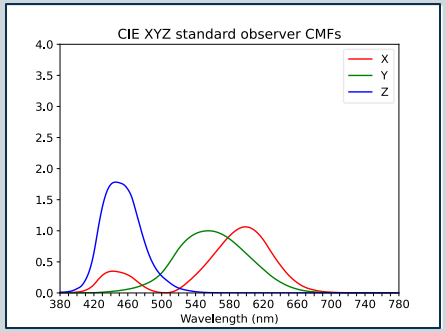
Contributions

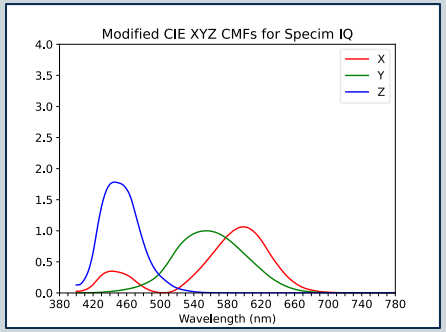
- HSI vs RGB

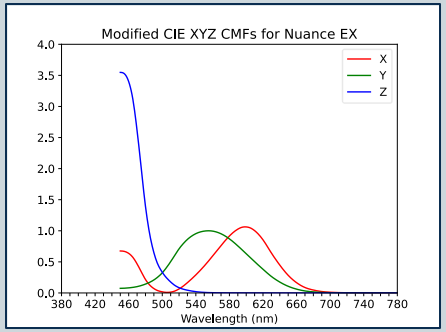




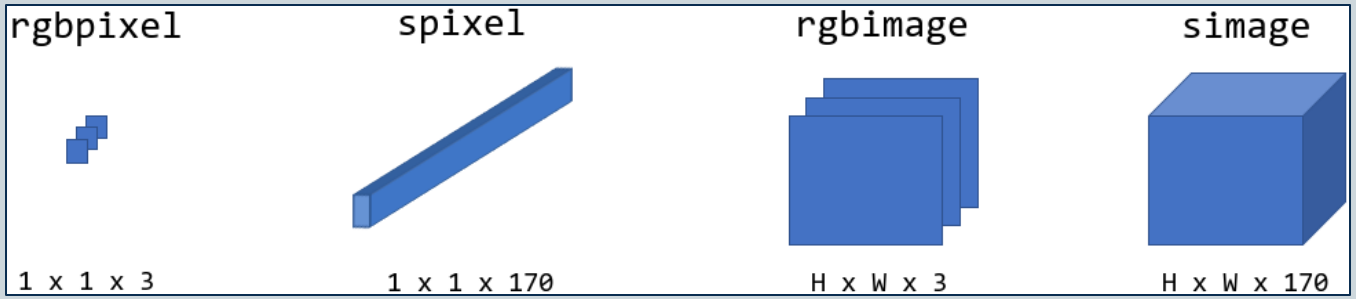
- Conversion of HSI to RGB with support for missing side bands





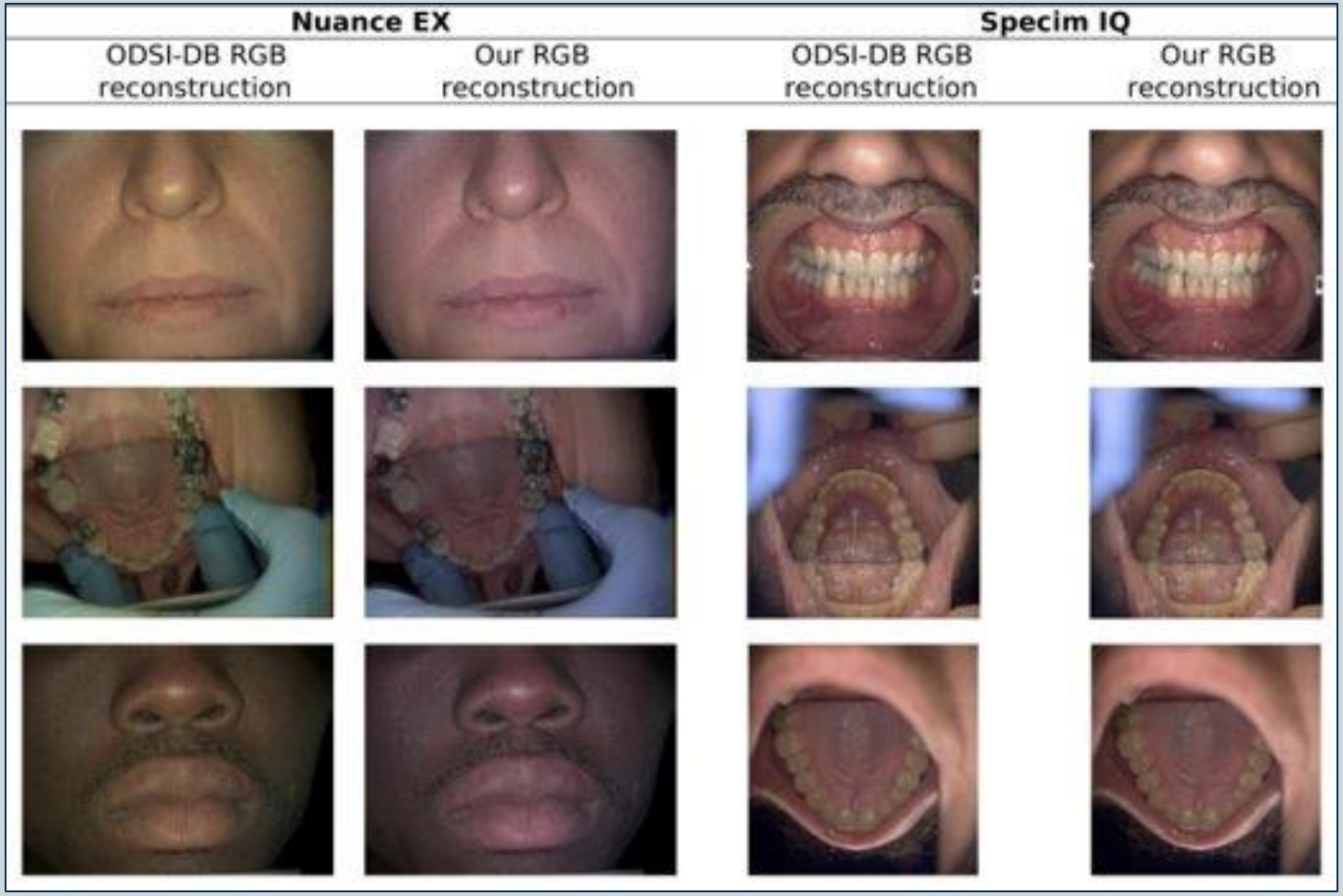


- Ablation study: spatial vs spectral



Results: HSI to RGB

- Converting HSI to RGB:



Results: Pixel Classification

Input type	Accuracy (%)
RGB pixels	39.39
Hyperspectral pixels	49.48
RGB images	52.51
Hyperspectral images	**54.98**

- **RGB pixels**

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)	Balanced Accuracy (%)
Attached gingiva	54.89	68.08	67.74	**61.49**
Enamel	56.52	69.98	68.64	63.25
Hair	100.00	68.48	68.94	84.24
Hard palate	44.01	68.63	66.40	56.32
Lip	47.80	68.15	66.72	57.98
Oral mucosa	42.95	68.37	66.16	55.66
Skin	38.86	69.33	62.48	54.10
Soft palate	0.00	67.37	67.12	33.68
Tongue	2.14	62.77	54.61	32.46
Average	43.02	67.91	65.42	55.46

- **RGB images**

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)	Balanced Accuracy (%)
Attached gingiva	26.23	99.94	98.00	63.09
Enamel	49.40	99.04	94.11	74.22
Hair	84.77	98.94	98.73	**91.85**
Hard palate	0.53	99.64	90.64	50.08
Lip	33.94	98.91	94.34	66.43
Oral mucosa	78.03	92.09	90.87	85.06
Skin	78.19	97.22	92.94	87.71
Soft palate	49.13	99.42	99.23	74.27
Tongue	56.48	97.20	91.73	76.84
Average	50.74	98.04	94.51	74.39

- **Hyperspectral pixels**

Attached gingiva	54.73	68.09	67.74	61.41
Enamel	67.49	68.00	67.95	**67.74**
Hair	100.00	68.48	68.94	84.24
Hard palate	44.01	68.64	66.40	56.32
Lip	60.00	66.77	66.30	**63.39**
Oral mucosa	42.94	68.48	66.26	**55.71**
Skin	39.33	69.07	62.38	**54.20**
Soft palate	0.00	67.37	67.12	33.68
Tongue	2.14	62.77	54.61	32.46
Average	45.63	67.52	65.30	**56.57**

- **Hyperspectral images**

Attached gingiva	40.64	99.48	97.93	**70.06**
Enamel	52.61	98.67	94.09	**75.64**
Hair	69.61	99.87	99.43	84.74
Hard palate	2.91	99.68	90.89	**51.29**
Lip	60.49	99.70	96.94	**80.09**
Oral mucosa	64.09	84.95	83.14	74.52
Skin	86.05	94.94	92.94	**90.49**
Soft palate	55.18	98.82	98.66	**77.00**
Tongue	64.58	98.99	94.36	**81.79**
Average	55.13	97.23	94.26	**76.18**

Resources

- Code, data, poster & presentation:

  github.com/luiscarlosgph/segodsidb

- Visit **Poster #22**

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Thank you

Contact details/for more information

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