Supplementary Material

MeshMonk: open-source large-scale intensive 3D phenotyping

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# Supplementary Data

**Supplementary Table 1.** Descriptive data for the validation sample used. These data were included only to describe the variation present in the sample and were not used as covariates in statistical analyses.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ID | Sex | Age | Height (cm) | Weight (kg) | Self-identified population | Camera |
| 61549 | F | 33 | 155.00 | 48.00 | Admixed African and European | 2006, 2-pod |
| 61587 | F | 20 | 158.00 | 43.00 | Italian | 2006, 2-pod |
| 61622 | M | 21 | 175.00 | 71.99 | Italian | 2006, 2-pod |
| 62102 | M | 22 | 178.00 | 60.01 | Polish | 2006, 2-pod |
| 62588 | M | 21 | 172.00 | 57.02 | Portuguese | 2006, 2-pod |
| 62633 | M | 41 | 176.00 | 76.02 | Portuguese | 2006, 2-pod |
| 62659 | F | 28 | 169.00 | 57.02 | Portuguese | 2006, 2-pod |
| 62677 | M | 24 | 175.00 | 65.00 | Portuguese | 2006, 2-pod |
| 62695 | F | 30 | 165.00 | 66.00 | Portuguese | 2006, 2-pod |
| 63096 | F | 20 | 165.10 | 57.15 | Irish | 2006, 2-pod |
| 63123 | F | 27 | 165.00 | 57.15 | Irish | 2006, 2-pod |
| 63151 | F | 43 | 165.10 | 69.85 | Irish | 2006, 2-pod |
| 63156 | M | 19 | 184.00 | 60.33 | Irish | 2006, 2-pod |
| 63173 | M | 19 | 180.00 | 66.00 | Irish | 2006, 2-pod |
| 131213 | M | 23 | 172.55 | 72.85 | Broadly European | 2013, 2-pod |
| 140241 | F | 33 | 160.70 | 57.40 | Unknown | 2014, 3-pod |
| 140268 | M | 19 | 179.00 | 103.80 | Mixed European and European American | 2014, 3-pod |
| 140679 | M | 62 | 166.00 | 63.30 | Mixed European and European American | 2014, 3-pod |
| 140721 | F | 26 | 165.00 | 101.30 | Mixed European and European American | 2014, 3-pod |
| 140739 | F | 73 | 169.00 | 83.00 | Mixed European and European American | 2014, 3-pod |
| 140956 | M | 21 | 168.60 | 70.80 | Broadly European | 2014, 3-pod |
| 141280 | F | 79 | 149.86 | 70.31 | Broadly European | 2014, 3-pod |
| 141527 | F | 66 | 170.18 | 97.07 | Mixed European and European American | 2014, 3-pod |
| 141563 | F | 24 | 154.94 | 52.16 | Mixed European and European American | 2014, 3-pod |
| 141706 | F | 63 | 170.18 | 81.65 | Broadly European | 2014, 3-pod |
| 141713 | F | 53 | 162.56 | 86.18 | Broadly European | 2014, 3-pod |
| 141869 | F | 25 | 152.40 | 46.72 | Mixed European and European American | 2014, 3-pod |
| 141875 | F | 55 | 165.10 | 62.60 | Mixed European and European American | 2014, 3-pod |
| 141913 | F | 20 | 162.56 | 68.04 | Mixed European and European American | 2014, 3-pod |
| 141979 | F | 65 | 157.48 | 54.43 | Mixed European and European American | 2014, 3-pod |
| 143007 | F | 27 | 156.40 | 62.40 | Mixed European and European American | 2014, 3-pod |
| 143076 | F | 19 | 181.00 | 68.40 | Mixed European and European American | 2014, 3-pod |
| 143093 | F | 18 | 179.00 | 65.00 | Broadly European | 2014, 3-pod |
| 143126 | F | 20 | 162.30 | 98.90 | Broadly European | 2014, 3-pod |
| 143162 | F | 19 | 170.00 | 75.70 | Broadly European | 2014, 3-pod |
| 143221 | F | 53 | 164.00 | 50.80 | Mixed European, Jewish | 2014, 3-pod |
| 143235 | F | 22 | 169.90 | 55.00 | Mixed European and European American | 2014, 3-pod |
| 143340 | M | 28 | 174.00 | 65.30 | Broadly European | 2014, 3-pod |
| 143578 | F | 23 | 161.00 | 78.20 | Broadly European | 2014, 3-pod |
| 143651 | F | 19 | 162.00 | 59.40 | Mixed European, Jewish | 2014, 3-pod |
| 143670 | F | 21 | 164.60 | 67.20 | Mixed European and European American | 2014, 3-pod |

# Supplementary Figures and Tables

## Supplementary Figures

## Supplementary Tables

**Supplementary Table 2**. Standard deviation of landmark iterations, summarized across individuals for each rater, then the average of the two raters. AZ and JW correspond to the average precision for rater AZ and rater JW, respectively. µ stands for the precision averaged across AZ and JW, or the average precision for both raters.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Landmark*** | ***Standard deviation between iterations (mm)*** | | | | | | | | |
| *X-dimension* | | | *Y-dimension* | | | *Z-dimension* | | |
| *AZ* | *JW* | *µ* | *AZ* | *JW* | *µ* | *AZ* | *JW* | *µ* |
| *Alar curvature left* | 0.2069 | 0.1471 | 0.1770 | 0.6795 | 0.5472 | 0.6133 | 0.6795 | 0.6074 | 0.6434 |
| *Alar curvature right* | 0.2076 | 0.1327 | 0.1702 | 0.7503 | 0.4612 | 0.6057 | 0.7503 | 0.5379 | 0.6441 |
| *Chelion left* | 0.8601 | 0.6703 | 0.7652 | 0.5386 | 0.3527 | 0.4456 | 0.5386 | 0.3184 | 0.4285 |
| *Chelion right* | 0.8074 | 0.7412 | 0.7743 | 0.4917 | 0.3465 | 0.4191 | 0.4917 | 0.3924 | 0.4421 |
| *Crista philtri left* | 0.5461 | 0.4327 | 0.4894 | 0.6676 | 0.2984 | 0.4830 | 0.6676 | 0.1812 | 0.4244 |
| *Crista philtri right* | 0.5518 | 0.4654 | 0.5086 | 0.7146 | 0.2520 | 0.4833 | 0.7146 | 0.1671 | 0.4409 |
| *Endocanthion left* | 0.9219 | 0.5506 | 0.7362 | 0.6269 | 0.3861 | 0.5065 | 0.6269 | 0.3749 | 0.5009 |
| *Endocanthion right* | 1.1879 | 0.5617 | 0.8748 | 0.5003 | 0.3647 | 0.4325 | 0.5003 | 0.4121 | 0.4562 |
| *Exocanthion left* | 0.6899 | 0.5032 | 0.5966 | 0.5058 | 0.4039 | 0.4548 | 0.5058 | 0.4069 | 0.4564 |
| *Exocanthion right* | 0.7402 | 0.4346 | 0.5874 | 0.5897 | 0.2882 | 0.4389 | 0.5897 | 0.3507 | 0.4702 |
| *Glabella* | 0.5627 | 0.4532 | 0.5080 | 0.8658 | 1.1696 | 1.0177 | 0.8658 | 0.4414 | 0.6536 |
| *Labiale inferius* | 0.5214 | 0.4183 | 0.4698 | 0.6100 | 0.3355 | 0.4727 | 0.6100 | 0.1987 | 0.4043 |
| *Labiale superius* | 0.4673 | 0.2968 | 0.3820 | 0.5861 | 0.3757 | 0.4809 | 0.5861 | 0.1274 | 0.3568 |
| *Nasion* | 0.3302 | 0.3132 | 0.3217 | 0.9321 | 0.8478 | 0.8900 | 0.9321 | 0.4595 | 0.6958 |
| *Pogonion* | 0.6464 | 0.6220 | 0.6342 | 1.2742 | 1.1558 | 1.2150 | 1.2742 | 0.5000 | 0.8871 |
| *Pronasale* | 0.4185 | 0.2994 | 0.3590 | 0.7104 | 0.4423 | 0.5763 | 0.7104 | 0.2053 | 0.4578 |
| *Subalare left* | 0.5524 | 0.5157 | 0.5340 | 0.3630 | 0.3075 | 0.3352 | 0.3630 | 0.4553 | 0.4091 |
| *Subalare right* | 0.5767 | 0.6422 | 0.6094 | 0.3144 | 0.3214 | 0.3179 | 0.3144 | 0.4909 | 0.4026 |
| *Subnasale* | 0.3765 | 0.3342 | 0.3554 | 0.6527 | 0.7196 | 0.6862 | 0.6527 | 0.3546 | 0.5037 |
| ***Mean*** | 0.5880 | 0.4492 | 0.5186 | 0.6512 | 0.4935 | 0.5724 | 0.6512 | 0.3675 | 0.5094 |
| ***AZ grand mean*** | 0.6302 |  |  |  |  |  |  |  |  |
| ***JW grand mean*** | 0.4367 |  |  |  |  |  |  |  |  |
| ***µ grand mean*** | 0.5334 |  |  |  |  |  |  |  |  |

**Supplementary Table 3.** Euclidean distance between landmark iterations, summarized across individuals for each rater, then the average of the two raters. AZ and JW correspond to the average distance for rater AZ and rater JW, respectively. µ stands for the distance averaged across AZ and JW, or the average distance for both raters.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Landmark*** | ***Euclidean distance between iterations (mm)*** | | | | | | | | |
| *1 to 2* | | | *1 to 3* | | | *2 to 3* | | |
| *AZ* | *JW* | *µ* | *AZ* | *JW* | *µ* | *AZ* | *JW* | *µ* |
| *Alar curvature left* | 1.5204 | 1.2183 | 1.3693 | 1.6184 | 1.1865 | 1.4025 | 1.7771 | 1.1168 | 1.4469 |
| *Alar curvature right* | 1.6214 | 0.9648 | 1.2931 | 1.6247 | 0.9975 | 1.3111 | 1.8571 | 1.0438 | 1.4505 |
| *Chelion left* | 1.6516 | 1.2470 | 1.4493 | 1.4901 | 1.3578 | 1.4239 | 1.3855 | 0.8962 | 1.1409 |
| *Chelion right* | 1.6301 | 1.4493 | 1.5397 | 1.5480 | 1.2988 | 1.4234 | 1.3009 | 0.9537 | 1.1273 |
| *Crista philtri left* | 1.1893 | 0.8124 | 1.0009 | 1.3868 | 0.8368 | 1.1118 | 1.2741 | 0.7189 | 0.9965 |
| *Crista philtri right* | 1.3515 | 0.8393 | 1.0954 | 1.4204 | 0.8186 | 1.1195 | 1.3227 | 0.6270 | 0.9749 |
| *Endocanthion left* | 1.8173 | 1.1456 | 1.4814 | 2.2999 | 1.1734 | 1.7366 | 1.3665 | 0.9849 | 1.1757 |
| *Endocanthion right* | 2.1760 | 1.2676 | 1.7218 | 2.4592 | 1.1493 | 1.8042 | 1.2917 | 0.9486 | 1.1201 |
| *Exocanthion left* | 1.5675 | 1.2101 | 1.3888 | 1.3022 | 1.2898 | 1.2960 | 1.5966 | 0.7422 | 1.1694 |
| *Exocanthion right* | 1.7310 | 0.9893 | 1.3602 | 1.5474 | 0.9772 | 1.2623 | 1.5752 | 0.6483 | 1.1117 |
| *Glabella* | 1.5956 | 2.1432 | 1.8694 | 1.4930 | 1.9739 | 1.7335 | 1.5756 | 1.4513 | 1.5134 |
| *Labiale inferius* | 1.1358 | 0.8262 | 0.9810 | 1.3804 | 0.9438 | 1.1621 | 1.4526 | 0.8068 | 1.1297 |
| *Labiale superius* | 0.9074 | 0.8359 | 0.8717 | 1.2255 | 0.8174 | 1.0214 | 1.1972 | 0.4679 | 0.8326 |
| *Nasion* | 1.2728 | 1.6299 | 1.4514 | 1.6467 | 1.5918 | 1.6192 | 1.4836 | 1.0465 | 1.2651 |
| *Pogonion* | 1.7296 | 2.2560 | 1.9928 | 2.5619 | 2.1713 | 2.3666 | 2.2573 | 1.5096 | 1.8835 |
| *Pronasale* | 1.1923 | 0.8785 | 1.0354 | 1.3787 | 0.8414 | 1.1101 | 1.1855 | 0.7694 | 0.9774 |
| *Subalare left* | 1.2825 | 1.1081 | 1.1953 | 1.1068 | 1.1574 | 1.1321 | 1.3035 | 0.9074 | 1.1055 |
| *Subalare right* | 1.1893 | 1.3318 | 1.2606 | 1.2298 | 1.2040 | 1.2169 | 1.1776 | 1.1008 | 1.1392 |
| *Subnasale* | 1.1436 | 1.4541 | 1.2989 | 1.1468 | 1.2325 | 1.1897 | 1.2000 | 0.9824 | 1.0912 |
| ***Mean*** | 1.4582 | 1.2425 | 1.3503 | 1.5719 | 1.2115 | 1.3917 | 1.4516 | 0.9328 | 1.1922 |
| ***AZ grand mean*** | 1.4939 |  |  |  |  |  |  |  |  |
| ***JW grand mean*** | 1.1289 |  |  |  |  |  |  |  |  |
| ***µ grand mean*** | 1.3114 |  |  |  |  |  |  |  |  |