

NIR Iris Challenge Evaluation in Non-cooperative Environments: Segmentation and Localization Supplementary Material

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1. Introduction

In this supplementary material, we provide detailed challenge results in term of different evaluation metrics, including $E1$ (seeing Table 1), $E2$ (seeing Table 2), $mDice$ (seeing Table 3), $mHdis$ (seeing Table 4), and the overall ranking results (seeing Table 5), which are not covered in the main manuscript due to the page limit.

Besides, we would like to thank all the participants, especially those who submitted the results, as listed in Table 5.

Method	$E1(\%)$										Rank Sum
	Distance		Occlusion		Off-angle		M1		Africa		
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	
NIR-ISL2021030401	0.3584	2	0.3961	1	0.3014	1	0.5293	2	0.3748	1	7
NIR-ISL2021030902	0.3658	3	0.4524	3	0.3574	6	0.535	4	0.397	4	20
NIR-ISL2021041402_3	0.3845	4	0.5056	17	0.3435	3	0.5318	3	0.4204	7	34
NIR-ISL2021030801	0.2269	1	0.4664	7	0.3754	10	0.5572	5	0.4432	13	36
NIR-ISL2021030701_5	0.4433	10	0.458	5	0.3687	8	0.6078	8	0.42	6	37
NIR-ISL2021041402_2	0.3991	7	0.4574	4	0.3394	2	0.7973	20	0.4138	5	38
NIR-ISL2021031401_2	0.4	9	0.4458	2	0.3664	7	0.834	21	0.3811	3	42
NIR-ISL2021030701_1	0.4677	13	0.4676	8	0.3734	9	0.6268	11	0.427	10	51
NIR-ISL2021030701_7	0.4559	11	0.4706	10	0.3949	12	0.6266	10	0.4324	11	54
NIR-ISL2021041402_1	0.3845	4	0.5056	17	0.3435	3	0.8349	23	0.4204	7	54
NIR-ISL2021041402_4	0.3845	4	0.5056	17	0.3435	3	0.8349	23	0.4247	9	56
NIR-ISL2021030701_6	0.4639	12	0.4822	11	0.3893	11	0.6356	13	0.4387	12	59
NIR-ISL2021031401_1	0.3991	7	0.4906	13	0.4092	20	0.834	21	0.3808	2	63
NIR-ISL2021031601_3	0.5403	22	0.4677	9	0.3981	13	0.6067	7	0.4878	19	70
NIR-ISL2021030701_3	0.4746	14	0.4948	14	0.4036	16	0.6598	15	0.4505	14	73
NIR-ISL2021031601_1	0.5185	20	0.484	12	0.3997	15	0.6164	9	0.4797	18	74
NIR-ISL2021031601_4	0.5387	21	0.465	6	0.4065	19	0.6271	12	0.4766	17	75
NIR-ISL2021030701_2	0.4883	17	0.4991	15	0.4048	18	0.6533	14	0.4539	16	80
NIR-ISL2021030701_4	0.4746	14	0.5295	21	0.4036	16	0.6598	15	0.4505	14	80
NIR-ISL2021030101	0.668	24	0.5161	20	0.3986	14	0.5169	1	0.5417	22	81
NIR-ISL2021022201	0.4773	16	0.5492	22	0.4477	22	0.5722	6	0.4972	20	86
NIR-ISL2021031601_2	0.6088	23	0.5021	16	0.4391	21	0.6683	18	0.5053	21	99
NIR-ISL2021022301_1	0.501	18	0.6553	24	0.514	23	0.6607	17	0.9151	24	106
NIR-ISL2021022801	0.5047	19	0.6045	23	0.5669	24	0.892	26	0.6054	23	115
NIR-ISL2021031901	1.0898	27	1.0826	26	1.0738	27	0.6865	19	1.0412	27	126
NIR-ISL2021022301_2	0.7592	26	0.9135	25	1.0384	26	0.8488	25	1.0129	26	128
NIR-ISL2021022601	0.7361	25	1.1194	27	0.9796	25	1.1915	27	1.0057	25	129

Table 1. Comparative assessment of different entries on the $E1$ metric. A ranking score is assigned to each algorithm according to its performance in the $E1$ metric, obtained from each testing set (Distance: CASIA-Iris-Distance, Occlusion: CASIA-Iris-Complex-Occlusion, Off-angle: CASIA-Iris-Complex-Off-angle, M1: CASIA-Iris-M1, Africa: CASIA-Iris-Africa). The entries are listed in a descending order based on their rank sum. The smaller the $E1$, the better the performance of iris segmentation.

Method	$E2(\%)$										Rank Sum
	Distance		Occlusion		Off-angle		M1		Africa		
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	
NIR-ISL2021030401	0.1792	2	0.1981	1	0.1507	1	0.2646	2	0.1874	1	7
NIR-ISL2021030902	0.1829	3	0.2262	3	0.1787	6	0.2675	4	0.1985	4	20
NIR-ISL2021041402_3	0.1922	4	0.2528	17	0.1718	3	0.2659	3	0.2102	7	34
NIR-ISL2021030801	0.1135	1	0.2332	7	0.1877	10	0.2786	5	0.2216	13	36
NIR-ISL2021030701_5	0.2217	10	0.229	5	0.1843	8	0.3039	8	0.21	6	37
NIR-ISL2021041402_2	0.1995	7	0.2287	4	0.1697	2	0.3986	20	0.2069	5	38
NIR-ISL2021031401_2	0.2	9	0.2229	2	0.1832	7	0.417	21	0.1905	3	42
NIR-ISL2021030701_1	0.2339	13	0.2338	8	0.1867	9	0.3134	11	0.2135	10	51
NIR-ISL2021030701_7	0.228	11	0.2353	10	0.1974	12	0.3133	10	0.2162	11	54
NIR-ISL2021041402_1	0.1922	4	0.2528	17	0.1718	3	0.4174	23	0.2102	7	54
NIR-ISL2021041402_4	0.1922	4	0.2528	17	0.1718	3	0.4174	23	0.2124	9	56
NIR-ISL2021030701_6	0.232	12	0.2411	11	0.1946	11	0.3178	13	0.2194	12	59
NIR-ISL2021031401_1	0.1996	8	0.2453	13	0.2046	20	0.417	21	0.1904	2	64
NIR-ISL2021031601_3	0.2702	22	0.2338	8	0.1991	13	0.3034	7	0.2439	19	69
NIR-ISL2021030701_3	0.2373	14	0.2474	14	0.2018	16	0.3299	15	0.2253	14	73
NIR-ISL2021031601_1	0.2593	20	0.242	12	0.1998	15	0.3082	9	0.2399	18	74
NIR-ISL2021031601_4	0.2693	21	0.2325	6	0.2033	19	0.3135	12	0.2383	17	75
NIR-ISL2021030701_2	0.2441	17	0.2495	15	0.2024	18	0.3266	14	0.227	16	80
NIR-ISL2021030701_4	0.2373	14	0.2648	21	0.2018	16	0.3299	15	0.2253	14	80
NIR-ISL2021030101	0.334	24	0.2581	20	0.1993	14	0.2584	1	0.2709	22	81
NIR-ISL2021022201	0.2387	16	0.2746	22	0.2239	22	0.2861	6	0.2486	20	86
NIR-ISL2021031601_2	0.3044	23	0.2511	16	0.2195	21	0.3341	18	0.2527	21	99
NIR-ISL2021022301_1	0.2505	18	0.3276	24	0.257	23	0.3303	17	0.4576	24	106
NIR-ISL2021022801	0.2523	19	0.3022	23	0.2835	24	0.446	26	0.3027	23	115
NIR-ISL2021031901	0.5449	27	0.5413	26	0.5369	27	0.3432	19	0.5206	27	126
NIR-ISL2021022301_2	0.3796	26	0.4568	25	0.5192	26	0.4244	25	0.5064	26	128
NIR-ISL2021022601	0.3681	25	0.5597	27	0.4898	25	0.5957	27	0.5028	25	129

Table 2. Comparative assessment of different entries on the $E2$ metric. A ranking score is assigned to each algorithm according to its performance in the $E2$ metric, obtained from each testing set (Distance: CASIA-Iris-Distance, Occlusion: CASIA-Iris-Complex-Occlusion, Off-angle: CASIA-Iris-Complex-Off-angle, M1: CASIA-Iris-M1, Africa: CASIA-Iris-Africa). The entries are listed in a descending order based on their rank sum. The smaller the $E2$, the better the performance of iris segmentation.

Method	<i>mDice</i>										Rank Sum
	Distance		Occlusion		Off-angle		M1		Africa		
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	
NIR-ISL2021030401	0.9666	6	0.9734	1	0.9764	1	0.9691	11	0.964	1	20
NIR-ISL2021030902	0.9677	2	0.9649	13	0.9711	6	0.9767	4	0.9625	3	28
NIR-ISL2021041402_2	0.9662	7	0.9648	14	0.9742	2	0.9769	3	0.9617	4	30
NIR-ISL2021041402_3	0.9669	3	0.9533	18	0.9735	3	0.9764	5	0.961	6	35
NIR-ISL2021041402_1	0.9669	3	0.9533	18	0.9735	3	0.9758	6	0.961	6	36
NIR-ISL2021041402_4	0.9669	3	0.9533	18	0.9735	3	0.9758	6	0.9601	8	38
NIR-ISL2021031601_2	0.9629	17	0.9682	5	0.9704	7	0.9733	8	0.96	9	46
NIR-ISL2021031601_4	0.9639	8	0.9691	3	0.9689	11	0.9684	13	0.9574	11	46
NIR-ISL2021031601_1	0.9608	18	0.9694	2	0.9701	8	0.9707	9	0.9574	11	48
NIR-ISL2021031401_2	0.9568	20	0.9538	17	0.9694	10	0.978	1	0.9628	2	50
NIR-ISL2021031601_3	0.9631	16	0.969	4	0.9698	9	0.9691	11	0.957	13	53
NIR-ISL2021030801	0.9696	1	0.9596	15	0.9669	19	0.9704	10	0.9591	10	55
NIR-ISL2021030701_1	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_2	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_3	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_4	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_5	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_6	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021030701_7	0.9636	9	0.9656	6	0.9685	12	0.9604	15	0.9565	14	56
NIR-ISL2021031401_1	0.9595	19	0.9567	16	0.963	20	0.978	1	0.9617	4	60
NIR-ISL2021022201	0.9566	21	0.9447	21	0.9569	21	0.9683	14	0.9514	21	98
NIR-ISL2021030101	0.9365	22	0.9235	22	0.9236	23	0.951	22	0.9004	22	111
NIR-ISL2021022301_1	0.9153	24	0.9042	24	0.9258	22	0.898	25	0.8134	25	120
NIR-ISL2021022801_1	0.8559	26	0.9229	23	0.9103	24	0.9317	24	0.8772	24	121
NIR-ISL2021031901	0.8641	25	0.882	25	0.8737	25	0.9364	23	0.8786	23	121
NIR-ISL2021022601	0.9213	23	0.8815	26	0.8684	26	0.8927	26	0.7458	27	128
NIR-ISL2021022301_2	0.8064	27	0.7688	27	0.821	27	0.7843	27	0.8003	26	134

Table 3. Comparative assessment of different entries on the *mDice* metric. A ranking score is assigned to each algorithm according to its performance in the *mDice* metric, obtained from each testing set (Distance: CASIA-Iris-Distance, Occlusion: CASIA-Iris-Complex-Occlusion, Off-angle: CASIA-Iris-Complex-Off-angle, M1: CASIA-Iris-M1, Africa: CASIA-Iris-Africa). The entries are listed in a descending order based on their rank sum. The bigger the *mDice*, the better the performance of iris localization.

Method	<i>mHdis</i>										Rank Sum
	Distance		Occlusion		Off-angle		M1		Africa		
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	
NIR-ISL2021031601_2	0.0061	5	0.0069	2	0.0066	2	0.005	6	0.0069	3	18
NIR-ISL2021030401	0.0065	7	0.0068	1	0.0061	1	0.0058	12	0.0064	1	22
NIR-ISL2021041402_2	0.0062	6	0.0088	14	0.0066	2	0.0047	1	0.007	5	28
NIR-ISL2021031601_4	0.006	1	0.0071	4	0.0071	8	0.0055	11	0.0074	11	35
NIR-ISL2021041402_1	0.006	1	0.0152	21	0.0066	2	0.0049	4	0.0072	7	35
NIR-ISL2021041402_3	0.006	1	0.0152	21	0.0066	2	0.005	6	0.0072	7	37
NIR-ISL2021041402_4	0.006	1	0.0152	21	0.0066	2	0.0049	4	0.0073	9	37
NIR-ISL2021031601_3	0.0065	7	0.0071	4	0.007	7	0.0054	10	0.0074	11	39
NIR-ISL2021030902	0.0065	7	0.0087	13	0.0074	10	0.0052	8	0.0071	6	44
NIR-ISL2021031601_1	0.0066	17	0.007	3	0.0071	8	0.0052	8	0.0075	13	49
NIR-ISL2021030701_1	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_2	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_3	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_4	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_5	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_6	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021030701_7	0.0065	7	0.0074	6	0.0075	11	0.007	15	0.0075	13	52
NIR-ISL2021031401_2	0.008	20	0.0104	16	0.0079	18	0.0047	1	0.0068	2	57
NIR-ISL2021031401_1	0.0077	19	0.0108	17	0.0089	20	0.0047	1	0.0069	3	60
NIR-ISL2021030801	0.0072	18	0.0088	14	0.0081	19	0.0062	13	0.0073	9	73
NIR-ISL2021030101	0.01	22	0.0118	18	0.0139	22	0.0069	14	0.0137	22	98
NIR-ISL2021022201	0.0086	21	0.0142	20	0.0115	21	0.0071	22	0.009	21	105
NIR-ISL2021022801_1	0.0183	25	0.0128	19	0.0218	25	0.011	23	0.0159	23	115
NIR-ISL2021031901	0.0222	26	0.0225	24	0.0207	24	0.0124	24	0.0189	24	122
NIR-ISL2021022301_1	0.0151	24	0.024	25	0.0158	23	0.0203	25	0.0372	26	123
NIR-ISL2021022601	0.0132	23	0.0273	26	0.0268	26	0.0279	26	0.0557	27	128
NIR-ISL2021022301_2	0.0295	27	0.0417	27	0.0308	27	0.036	27	0.0285	25	133

Table 4. Comparative assessment of different entries on the *mHdis* metric. A ranking score is assigned to each algorithm according to its performance in the *mHdis* metric, obtained from each testing set (Distance: CASIA-Iris-Distance, Occlusion: CASIA-Iris-Complex-Occlusion, Off-angle: CASIA-Iris-Complex-Off-angle, M1: CASIA-Iris-M1, Africa: CASIA-Iris-Africa). The entries are listed in a descending order based on their rank sum. The smaller the *mHdis*, the better the performance of iris localization.

Team	Affiliation	Participants Name	Method	Iris Segmentation		Iris Localization		Rank Sum	Ranking
				<i>E1</i> (Rank)	<i>E2</i> (Rank)	<i>mDice</i> (Rank)	<i>mHdis</i> (Rank)		
Fraunhofer IGD	Fraunhofer Institute for Computer Graphics Research IGD, Darmstadt, Germany; Mathematical and Applied Visual Computing, TU Darmstadt, Darmstadt, Germany	Fadi Boutros, Naser Damer and Arjan Kuijper	NIR-ISL2021022201	86	86	98	105	375	22
hda/TOC	Darmstadt University of Applied Sciences (Hochschule Darmstadt); TOC Biometrics	Juan Tapia, Andres Valenzuela and Christoph Busch	NIR-ISL2021022301_1 NIR-ISL2021022301_2	106 128	106 128	120 134	123 133	455 523	23 27
University of Ljubljana	University of Ljubljana, Slovenia	Leon Premk, Matej Vitek, Vitomir Štruc and Peter Peer	NIR-ISL2021022601	129	129	128	128	514	26
Cosmic Vision	Norwegian University of Science and Technology (NTNU), Norway	Gourav Gupta and Kiran Raja	NIR-ISL2021022801	115	115	121	115	466	24
DreamMaker	JiLin University	Ye Sun and Zhiyong Zhou	NIR-ISL2021030101	81	81	111	98	371	21
Lao Yang Sprint Team	School of Biomedical Engineering, Southern Medical University	Yiwen Zhang, Tianbao Liu, and Wei Yang	NIR-ISL2021030401	7	7	20	22	56	1
DLUT_VLG	Dalian University of Technology	Xueyu Shi, Shao Zeng and Peihua Li	NIR-ISL2021030701_1	51	51	56	52	210	10
			NIR-ISL2021030701_2	80	80	56	52	268	19
			NIR-ISL2021030701_3	73	73	56	52	254	17
			NIR-ISL2021030701_4	80	80	56	52	268	19
			NIR-ISL2021030701_5	37	37	56	52	182	6
			NIR-ISL2021030701_6	59	59	56	52	226	12
			NIR-ISL2021030701_7	54	54	56	52	216	11
iristar	IriStar Technology Co., Ltd, China	Huijie Wu, Xinhui Zhang and Haiqing Li	NIR-ISL2021030801	36	36	55	73	200	9
SUEP-Pixsur	Shanghai University of Electric Power	Dongliang Wu, Yingfeng Liu, Ruiye Zhou and Huihai Wu	NIR-ISL2021030902	20	20	28	44	112	2
KartalOI [†]	Warsaw University of Technology, Poland; Arak University, Iran; Lorestan University, Iran; Shahid Beheshti University, Iran; University of Kharazmi, Iran; Stanford University, USA	Jalil Nourmohammadi Khiarak, Farhang Jaryani, Samaneh Salehi Nasab, Seyed Naeim Moafinejad, Yasin Amini and Morteza Noshad	NIR-ISL2021031301	N/A	N/A	N/A	N/A	N/A	N/A
insight	College of Sciences, Northeastern University, Shenyang, China	Haodong Sun, Jing Wang, Jiale Zhang and Qi Wang	NIR-ISL2021031401_1	63	64	60	60	247	16
			NIR-ISL2021031401_2	42	42	50	57	191	8
IRIS team	Xian Quanxiu Technology Co., Ltd, China	Yu Chen, Liang Chen and Menghan Zhang	NIR-ISL2021031601_1	74	74	48	49	245	15
			NIR-ISL2021031601_2	99	99	46	18	262	18
			NIR-ISL2021031601_3	70	69	53	39	231	13
			NIR-ISL2021031601_4	75	75	46	35	231	13
CKB	Chengdu University of Information Technology, Chengdu, China; Keya Medical, Seattle, WA, USA; University at Buffalo, Buffalo, NY, USA	Xi Wu, Xiaojie Li, Jingfu Yang, Hongyan Jing, Xin Wang, Bin Kong, Youbing Yin, Qi Song, Siwei Lyu and Shu Hu	NIR-ISL2021031901	126	126	121	122	495	25
EyeCool	College of Science, Northeastern University	Hao Zhang, Junbao Wang, Jiayi Wang and Wantong Xiong	NIR-ISL2021041402_1	54	54	36	35	179	5
			NIR-ISL2021041402_2	38	38	30	28	134	3
			NIR-ISL2021041402_3	34	34	35	37	140	4
			NIR-ISL2021041402_4	56	56	38	37	187	7

[†] The KartalOI team is not reported because of issues with the submitted results.

Table 5. The ranking results from the NIR-ISL 2021. The first-place team is labeled in red, the second-place team is labeled in green, while the third-place team is labeled in cyan.