

Supplementary Tables

Supplementary tables to the manuscript

Influence of interpolation method on rotation invariance in texture recognition

These tables lists the data illustrated in Figure 5 and 7.

Table 3. The mean classification accuracies (in %) are listed for each descriptor–interpolation method pair and for the eight orientations 40° to 320° . Values in brackets are standard deviations. Column marked “Mean” and “Std.” show the mean and standard deviation of classification accuracies over the eight orientations.

		Mean	Std.	40°	80°	120°	160°	200°	240°	280°	320°
LBP _{8,1}	HW	52.8	(8.9)	52.5 (2.0)	48.4 (2.8)	43.5 (2.2)	63.7 (1.8)	68.1 (2.5)	49.1 (2.1)	43.5 (2.1)	54.0 (1.7)
	NN	24.8	(6.7)	18.4 (0.7)	34.0 (2.1)	20.3 (1.3)	25.6 (0.9)	28.1 (1.4)	19.2 (1.5)	34.2 (1.6)	18.5 (1.6)
	LN	12.2	(2.8)	11.8 (1.1)	10.0 (1.2)	12.1 (1.6)	13.7 (1.6)	18.2 (1.4)	12.2 (1.0)	9.6 (0.9)	10.0 (1.1)
	CU	32.7	(8.0)	32.3 (2.6)	25.8 (2.0)	26.8 (1.5)	43.1 (2.1)	46.7 (2.3)	28.9 (1.6)	26.3 (1.7)	31.4 (2.5)
	SP	48.3	(10.7)	49.0 (2.6)	40.4 (2.5)	38.9 (2.1)	60.9 (0.9)	67.2 (2.3)	43.0 (2.4)	38.3 (2.2)	48.5 (2.2)
	LZ	52.5	(11.0)	53.5 (3.3)	44.5 (1.6)	42.3 (1.7)	65.0 (0.9)	72.2 (2.6)	46.4 (2.1)	42.8 (1.8)	52.9 (2.3)
LBP _{8,1} ⁱ	HW	77.4	(3.3)	75.0 (1.7)	78.8 (2.3)	75.6 (1.9)	79.3 (2.3)	83.1 (1.8)	79.8 (2.4)	73.5 (1.8)	74.5 (2.3)
	NN	19.7	(12.4)	10.7 (1.1)	39.6 (1.9)	12.5 (1.2)	16.5 (1.8)	15.8 (1.2)	12.0 (0.9)	39.5 (1.5)	11.1 (0.8)
	LN	19.9	(1.2)	19.0 (1.0)	19.2 (1.2)	21.4 (1.5)	20.8 (1.5)	19.9 (1.5)	21.6 (1.5)	18.6 (0.9)	19.1 (1.0)
	CU	43.5	(1.9)	40.6 (1.3)	45.5 (1.6)	45.2 (2.1)	43.5 (1.5)	43.4 (1.9)	43.2 (2.4)	45.3 (2.9)	41.0 (3.4)
	SP	72.2	(3.5)	66.9 (2.6)	76.9 (2.0)	73.0 (2.1)	73.6 (1.4)	72.1 (2.8)	72.0 (1.7)	75.7 (3.1)	67.8 (2.1)
	LZ	80.3	(4.3)	74.6 (2.6)	85.5 (2.4)	79.0 (2.5)	83.1 (2.6)	81.7 (1.3)	78.9 (1.8)	84.9 (2.2)	74.5 (1.8)
LBP _{8,1} ^{DFT}	HW	79.4	(4.6)	72.8 (1.5)	82.5 (2.2)	75.9 (3.0)	85.2 (2.5)	83.1 (1.2)	82.9 (2.3)	75.2 (2.0)	77.6 (1.5)
	NN	31.0	(20.1)	15.7 (1.0)	64.8 (2.1)	18.2 (1.2)	27.2 (1.4)	27.2 (1.6)	17.8 (1.6)	60.6 (2.1)	16.5 (1.2)
	LN	22.3	(3.4)	18.2 (1.3)	27.5 (2.0)	21.8 (1.6)	22.7 (1.4)	19.0 (1.2)	23.5 (1.8)	26.2 (1.1)	19.2 (1.1)
	CU	58.2	(6.8)	49.0 (2.4)	68.2 (2.4)	52.0 (1.3)	59.3 (1.8)	57.2 (1.7)	58.7 (1.8)	67.2 (2.6)	53.6 (2.6)
	SP	81.4	(6.3)	72.6 (2.3)	89.2 (1.4)	75.8 (1.1)	85.2 (1.6)	81.8 (1.8)	82.5 (1.6)	88.7 (1.2)	75.2 (2.5)
	LZ	85.2	(6.0)	76.9 (1.7)	92.2 (0.8)	79.8 (1.3)	88.4 (1.3)	86.0 (1.3)	86.7 (2.0)	92.4 (1.3)	79.0 (2.6)
LTP _{8,1} ^{DFT}	HW	89.6	(3.9)	84.1 (1.4)	91.1 (1.4)	86.3 (1.4)	96.1 (1.1)	93.5 (1.5)	89.3 (1.6)	87.5 (2.0)	88.5 (1.6)
	NN	39.5	(24.8)	20.3 (1.0)	79.2 (1.8)	22.1 (1.3)	37.2 (1.9)	38.0 (1.1)	22.4 (1.0)	76.8 (1.9)	20.4 (1.6)
	LN	46.1	(3.8)	41.0 (2.1)	48.7 (1.4)	49.8 (1.7)	46.3 (1.8)	45.5 (0.8)	49.9 (1.9)	47.9 (2.7)	39.9 (2.3)
	CU	81.7	(2.6)	77.1 (1.5)	83.9 (2.2)	80.9 (1.8)	82.7 (2.1)	81.8 (2.3)	83.5 (1.8)	84.6 (2.0)	78.7 (2.0)
	SP	94.2	(2.2)	90.7 (1.2)	96.8 (0.7)	92.6 (1.5)	95.8 (0.7)	94.3 (1.3)	94.4 (0.9)	96.8 (1.1)	92.6 (1.2)
	LZ	95.6	(1.9)	92.8 (1.0)	97.9 (0.8)	93.6 (1.2)	97.1 (1.0)	95.5 (1.6)	95.6 (1.4)	97.8 (0.8)	94.2 (0.9)
ILBP _{8,1}	HW	52.0	(7.3)	54.5 (1.2)	48.1 (2.6)	42.9 (1.3)	62.4 (2.3)	61.1 (2.4)	49.8 (0.9)	43.7 (2.2)	53.5 (1.2)
	NN	20.7	(9.2)	15.0 (1.3)	31.4 (2.2)	11.2 (0.7)	24.4 (1.4)	26.4 (1.4)	11.7 (1.0)	33.3 (1.5)	12.4 (1.0)
	LN	18.2	(2.8)	17.1 (1.5)	14.5 (1.3)	19.0 (1.8)	21.3 (1.7)	23.1 (2.4)	17.3 (2.1)	15.9 (2.6)	17.3 (1.7)
	CU	40.0	(7.0)	44.3 (2.2)	33.1 (1.5)	34.1 (2.7)	48.4 (2.4)	50.3 (2.6)	37.0 (1.2)	32.6 (2.8)	40.4 (2.3)
	SP	48.7	(8.3)	52.6 (2.4)	40.0 (1.3)	42.6 (1.6)	59.4 (2.7)	60.8 (2.8)	43.2 (1.3)	41.0 (2.3)	49.7 (1.8)
	LZ	50.0	(8.3)	53.4 (2.7)	41.4 (1.4)	43.9 (2.0)	61.2 (2.3)	62.2 (2.8)	44.6 (1.8)	42.5 (2.2)	50.7 (1.5)
ILBP _{8,1} ⁱ	HW	86.0	(2.2)	82.2 (2.2)	89.4 (1.4)	85.4 (1.7)	88.1 (1.3)	86.7 (1.6)	86.5 (2.3)	84.4 (1.3)	85.3 (2.0)
	NN	30.7	(21.3)	14.6 (0.9)	63.9 (1.4)	17.4 (1.2)	26.9 (1.9)	26.7 (1.8)	16.6 (1.2)	64.5 (2.0)	14.5 (1.5)
	LN	26.7	(2.4)	24.4 (1.4)	30.8 (1.4)	26.5 (2.1)	27.9 (2.0)	25.4 (2.7)	26.6 (1.4)	28.9 (1.3)	23.5 (2.3)
	CU	61.8	(2.7)	60.0 (2.1)	66.6 (1.3)	60.3 (1.5)	61.7 (1.4)	59.4 (2.4)	60.7 (1.0)	65.2 (2.7)	60.4 (1.8)
	SP	83.4	(3.1)	82.0 (2.6)	88.4 (2.4)	81.7 (2.0)	83.1 (2.2)	81.6 (2.3)	80.8 (2.4)	88.2 (1.6)	81.1 (2.6)
	LZ	87.3	(3.2)	86.4 (2.0)	93.0 (1.6)	85.4 (1.5)	87.1 (1.4)	86.0 (1.8)	83.8 (2.3)	91.4 (1.4)	85.2 (2.8)
ILBP _{8,1} ^{DFT}	HW	79.4	(6.2)	71.8 (1.8)	88.6 (1.7)	74.3 (1.8)	87.3 (2.1)	78.4 (1.6)	76.3 (2.3)	83.0 (0.9)	75.9 (1.7)
	NN	33.2	(24.2)	17.1 (0.9)	73.7 (2.0)	17.7 (1.0)	25.8 (1.7)	25.9 (1.4)	17.5 (0.9)	70.0 (2.5)	17.4 (1.2)
	LN	28.6	(7.7)	23.8 (2.5)	40.4 (1.1)	24.5 (2.4)	29.2 (1.7)	22.7 (1.8)	25.4 (1.8)	40.6 (1.8)	21.8 (1.5)
	CU	64.4	(7.3)	60.4 (1.8)	76.3 (1.7)	59.3 (1.6)	66.1 (2.0)	59.1 (2.6)	59.2 (1.2)	75.1 (1.6)	59.5 (3.5)
	SP	79.8	(7.6)	74.9 (1.4)	91.6 (1.2)	74.4 (1.7)	82.5 (2.4)	75.7 (1.3)	73.7 (2.6)	91.0 (1.4)	74.5 (1.9)
	LZ	82.2	(7.7)	77.6 (1.5)	93.7 (1.4)	76.5 (1.9)	84.6 (1.8)	78.5 (2.0)	76.4 (2.6)	94.3 (1.3)	76.3 (2.2)
ILTP _{8,1} ^{DFT}	HW	90.4	(3.7)	87.9 (1.7)	94.8 (1.3)	86.4 (0.9)	94.1 (0.9)	90.5 (0.6)	85.1 (1.1)	91.1 (0.6)	93.6 (1.9)
	NN	61.5	(21.2)	43.9 (2.2)	95.6 (1.7)	47.6 (3.2)	60.4 (1.4)	60.6 (1.2)	46.5 (2.7)	92.6 (1.7)	44.5 (2.1)
	LN	64.1	(2.5)	64.3 (2.2)	66.6 (1.8)	65.5 (1.6)	62.5 (2.1)	59.7 (1.5)	62.2 (1.7)	67.3 (1.5)	65.0 (1.6)
	CU	83.5	(3.6)	84.4 (1.2)	87.5 (1.9)	81.1 (1.0)	84.1 (1.4)	80.1 (2.2)	77.8 (1.9)	88.1 (2.5)	84.6 (1.8)
	SP	91.7	(4.2)	92.1 (1.2)	96.4 (0.8)	87.6 (1.2)	92.8 (0.9)	88.8 (1.5)	85.3 (1.9)	96.9 (1.2)	93.7 (1.8)
	LZ	92.4	(4.4)	92.6 (1.5)	97.7 (0.8)	87.8 (1.2)	93.5 (0.9)	89.9 (1.2)	85.7 (1.6)	97.8 (1.1)	94.1 (1.5)

HW – hardware rotated, NN – nearest neighbour, LN – linear interpolation, CU – cubic interpolation, SP – spline interpolation, LZ – Lanczos 3 interpolation.

Table 4. The mean classification accuracies (in %) are listed for each descriptor–interpolation method pair when using 0° and 40° rotations for training. Values in brackets are standard deviations. Column marked “Mean” and “Std.” show the mean and standard deviation of classification accuracies over the seven orientations.

		Mean	Std.	80°	120°	160°	200°	240°	280°	320°
LBP _{s,1}	HW	63.0	(11.2)	58.1 (2.5)	52.5 (2.0)	67.7 (2.8)	82.1 (1.8)	70.1 (1.6)	49.7 (1.6)	60.7 (1.5)
	NN	48.5	(16.3)	32.5 (1.8)	55.1 (2.2)	32.9 (2.2)	50.8 (1.9)	73.8 (1.1)	33.1 (1.0)	61.6 (3.1)
	LN	55.1	(8.8)	55.6 (1.4)	45.1 (1.7)	51.1 (1.9)	69.0 (1.9)	65.2 (2.4)	49.3 (1.4)	50.2 (1.5)
	CU	57.3	(9.8)	56.8 (1.2)	47.7 (2.1)	57.4 (2.6)	71.8 (1.8)	68.9 (2.4)	47.6 (1.7)	50.6 (1.6)
	SP	59.5	(10.0)	58.1 (1.0)	49.1 (1.9)	62.2 (2.4)	73.0 (2.0)	71.7 (1.9)	48.0 (1.3)	54.4 (2.4)
	LZ	60.6	(10.4)	57.8 (1.0)	49.7 (1.5)	63.5 (2.0)	74.1 (3.0)	73.9 (2.3)	49.0 (1.5)	56.3 (2.8)
LBP _{s,1} ^{ri}	HW	92.6	(3.2)	90.5 (1.5)	94.4 (1.1)	92.8 (2.1)	94.5 (1.7)	96.4 (1.0)	86.6 (0.9)	93.1 (1.4)
	NN	54.9	(28.9)	38.1 (2.3)	82.1 (2.5)	26.9 (2.8)	25.2 (1.5)	82.4 (2.0)	38.2 (1.7)	90.9 (1.7)
	LN	92.9	(3.4)	89.6 (1.6)	91.1 (1.5)	95.5 (1.0)	95.7 (1.4)	90.3 (2.3)	89.9 (2.0)	98.0 (0.8)
	CU	94.5	(2.3)	91.6 (1.6)	95.8 (1.1)	94.9 (1.1)	93.9 (2.1)	93.9 (1.3)	91.5 (2.5)	97.9 (0.9)
	SP	95.2	(1.8)	93.9 (0.9)	96.3 (1.1)	94.0 (1.8)	93.7 (1.5)	96.7 (1.2)	93.6 (1.3)	97.9 (0.9)
	LZ	95.6	(1.5)	94.9 (1.6)	96.3 (0.9)	94.8 (1.5)	94.1 (1.2)	97.2 (1.1)	94.1 (1.6)	97.6 (0.8)
LBP _{DFT} _{s,1}	HW	92.1	(3.6)	89.1 (1.4)	93.6 (1.8)	94.2 (1.7)	94.5 (1.4)	95.0 (1.6)	85.3 (1.4)	93.3 (1.2)
	NN	70.7	(21.8)	64.7 (2.0)	92.6 (1.7)	48.5 (3.6)	43.2 (3.1)	91.7 (1.6)	60.5 (2.1)	93.8 (2.0)
	LN	89.2	(3.5)	87.2 (1.0)	94.2 (1.1)	88.9 (0.8)	86.8 (2.0)	89.3 (1.4)	84.7 (2.1)	93.4 (1.8)
	CU	93.7	(2.6)	95.1 (0.7)	96.5 (1.5)	94.3 (1.6)	89.4 (1.3)	91.4 (0.9)	93.0 (1.6)	96.1 (0.8)
	SP	95.1	(2.0)	96.1 (0.9)	97.4 (1.2)	96.0 (1.4)	91.2 (1.3)	93.8 (0.8)	95.1 (1.2)	95.9 (0.9)
	LZ	95.4	(1.9)	96.6 (1.2)	97.3 (1.3)	96.5 (1.3)	91.7 (1.2)	94.1 (0.8)	95.7 (1.1)	95.6 (1.3)
LTP _{DFT} _{s,1}	HW	96.9	(2.7)	94.2 (0.5)	99.3 (0.6)	98.5 (0.9)	97.2 (1.0)	97.8 (0.6)	92.3 (1.1)	99.4 (0.6)
	NN	86.3	(10.6)	79.1 (1.8)	97.8 (0.9)	77.7 (1.1)	78.1 (1.4)	96.6 (1.1)	76.7 (1.9)	98.4 (1.0)
	LN	96.4	(2.2)	97.1 (0.7)	97.8 (1.1)	97.8 (0.8)	92.2 (0.8)	95.1 (0.8)	95.9 (1.4)	98.8 (0.4)
	CU	97.9	(1.3)	98.5 (0.8)	98.5 (0.8)	98.9 (0.8)	95.4 (1.1)	96.8 (0.9)	98.4 (0.8)	99.0 (0.4)
	SP	98.3	(1.2)	98.7 (0.6)	99.0 (0.7)	99.2 (0.7)	95.9 (0.9)	97.4 (0.8)	99.0 (0.6)	99.2 (0.5)
	LZ	98.4	(1.1)	98.9 (0.6)	98.9 (0.7)	99.2 (0.7)	96.4 (0.8)	97.5 (0.8)	98.9 (0.5)	99.2 (0.5)
ILBP _{s,1}	HW	58.8	(7.2)	55.5 (2.0)	51.4 (1.1)	66.3 (1.9)	66.9 (2.2)	63.0 (1.8)	48.8 (2.1)	59.9 (1.8)
	NN	41.7	(10.1)	32.3 (2.3)	45.1 (1.9)	30.7 (2.4)	43.8 (2.0)	58.8 (1.5)	33.8 (1.6)	47.1 (1.8)
	LN	48.9	(8.0)	51.3 (2.8)	39.7 (1.5)	45.6 (2.5)	59.8 (2.1)	58.8 (1.5)	42.8 (2.4)	44.0 (1.8)
	CU	52.7	(7.5)	52.4 (1.4)	45.4 (2.0)	52.5 (1.7)	62.3 (2.6)	62.9 (1.8)	43.9 (2.0)	49.5 (2.7)
	SP	55.0	(7.4)	53.3 (1.9)	47.2 (2.2)	57.2 (2.6)	65.1 (2.4)	63.4 (2.3)	45.7 (2.6)	53.0 (2.5)
	LZ	55.2	(7.6)	52.9 (1.8)	47.2 (2.5)	58.5 (2.9)	65.2 (2.8)	63.9 (1.9)	45.9 (2.6)	53.0 (1.9)
ILBP _{s,1} ^{ri}	HW	94.6	(2.7)	93.6 (1.6)	96.2 (1.2)	96.0 (1.0)	95.6 (1.0)	96.3 (1.2)	88.7 (0.9)	95.8 (1.0)
	NN	69.6	(20.9)	63.2 (1.2)	87.4 (1.9)	45.7 (2.2)	43.8 (3.5)	87.7 (2.1)	63.8 (2.2)	95.5 (0.9)
	LN	93.1	(3.0)	88.8 (1.7)	94.3 (2.2)	93.7 (2.1)	96.1 (1.3)	92.7 (1.5)	89.8 (1.4)	96.6 (1.6)
	CU	95.5	(0.8)	95.1 (0.6)	96.5 (0.8)	95.7 (1.5)	95.4 (1.1)	95.5 (0.9)	94.0 (1.2)	96.3 (0.9)
	SP	96.1	(0.3)	96.1 (1.4)	96.5 (1.6)	96.2 (1.4)	95.7 (1.3)	96.3 (1.3)	95.7 (1.1)	96.4 (1.4)
	LZ	96.0	(0.6)	96.1 (1.6)	96.2 (1.2)	96.1 (0.9)	95.2 (0.9)	95.2 (1.3)	96.3 (0.7)	96.6 (0.7)
ILBP _{DFT} _{s,1}	HW	91.5	(3.0)	90.0 (2.0)	95.2 (2.1)	94.6 (1.4)	88.7 (1.0)	91.4 (1.8)	87.3 (1.3)	92.9 (1.0)
	NN	72.6	(14.6)	73.7 (2.0)	82.5 (1.9)	54.8 (2.1)	53.9 (1.9)	79.6 (1.4)	69.9 (2.5)	93.9 (1.7)
	LN	87.7	(3.5)	88.7 (1.2)	92.7 (1.1)	85.4 (1.3)	84.0 (1.5)	86.3 (1.5)	84.6 (1.7)	92.0 (1.4)
	CU	91.4	(2.9)	95.1 (1.2)	94.0 (1.2)	91.3 (2.3)	86.8 (2.0)	88.6 (1.1)	91.2 (1.3)	92.7 (1.0)
	SP	92.3	(2.7)	96.0 (0.7)	94.2 (1.3)	92.6 (2.2)	87.7 (2.3)	90.0 (1.5)	92.6 (1.5)	92.7 (1.4)
	LZ	92.4	(2.8)	95.9 (1.3)	94.7 (1.8)	93.3 (1.8)	87.7 (2.5)	90.2 (1.6)	93.1 (1.0)	92.2 (1.1)
ILTP _{DFT} _{s,1}	HW	97.0	(2.9)	95.6 (0.8)	99.9 (0.2)	99.6 (0.2)	96.3 (0.4)	96.2 (1.0)	92.0 (0.6)	99.7 (0.4)
	NN	96.7	(2.5)	95.6 (1.8)	99.3 (0.5)	96.4 (0.9)	95.3 (0.9)	98.2 (0.7)	92.6 (1.6)	99.7 (0.3)
	LN	97.8	(1.8)	98.8 (0.8)	98.7 (0.8)	99.3 (0.4)	95.3 (0.6)	95.0 (0.4)	98.8 (0.8)	98.9 (0.6)
	CU	98.5	(1.5)	99.5 (0.5)	99.4 (0.6)	99.4 (0.7)	96.2 (0.4)	96.3 (0.5)	99.2 (0.5)	99.5 (0.4)
	SP	98.8	(1.3)	99.5 (0.4)	99.5 (0.3)	99.8 (0.3)	96.7 (0.5)	97.1 (0.4)	99.6 (0.4)	99.6 (0.4)
	LZ	99.0	(1.2)	99.6 (0.4)	99.7 (0.3)	99.8 (0.3)	96.9 (0.5)	97.5 (0.9)	99.7 (0.3)	99.6 (0.4)

HW – hardware rotated, NN – nearest neighbour, LN – linear interpolation, CU – cubic interpolation, SP – spline interpolation, LZ – Lanczos 3 interpolation.