

Pedestrian Detection with Unsupervised Multi-Stage Feature Learning (Supplementary Material)

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1. Evidence for using the proposed continuous Area Under Curve measure

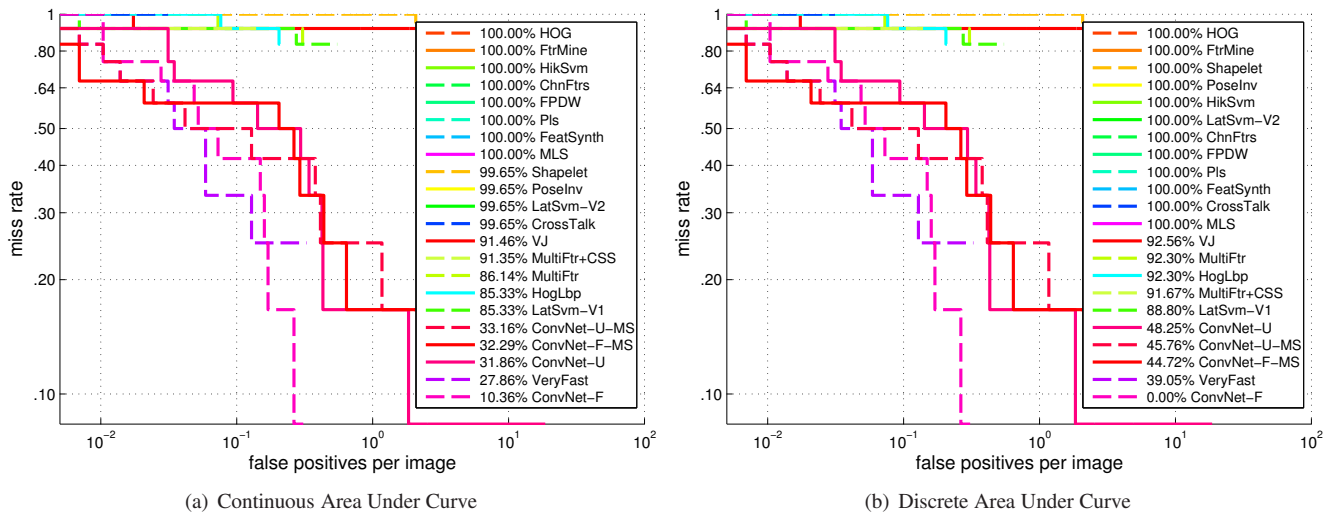
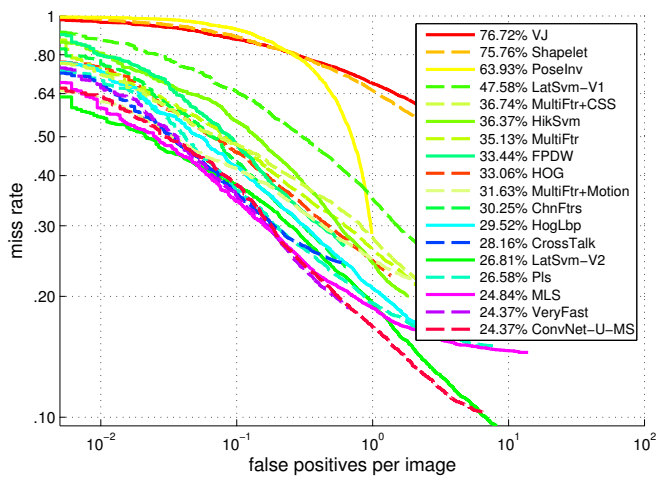
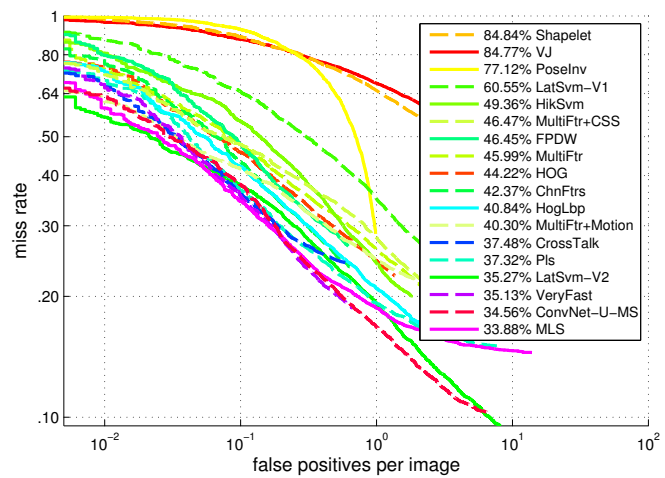


Figure 1: Differences between continuous (proposed) and discrete Area Under Curve (AUC) on the INRIA medium scale experiment. In 1(a), we compute the continuous AUC as opposed to a discrete AUC 1(b) based on a few points in the standard benchmarking software. 1(b) clearly shows the shortcomings of the discrete AUC which wrongly attributes a 0% AUC to ConvNet-F instead of 10.36%. Additionally, several models are re-ranked when using the continuous AUC.



(a) Continuous Area Under Curve



(b) Discrete Area Under Curve

Figure 2: **Another example of the effects of using the continuous AUC on the ETH large scale experiment.** Here several models get re-ranked, including Convnet-U-MS, VeryFast, LatSvm-V2, MultiFtr+Motion, FPDW, MultiFtr+CSS and Shapelet.

2. Evidence for using the proposed fixed INRIA dataset

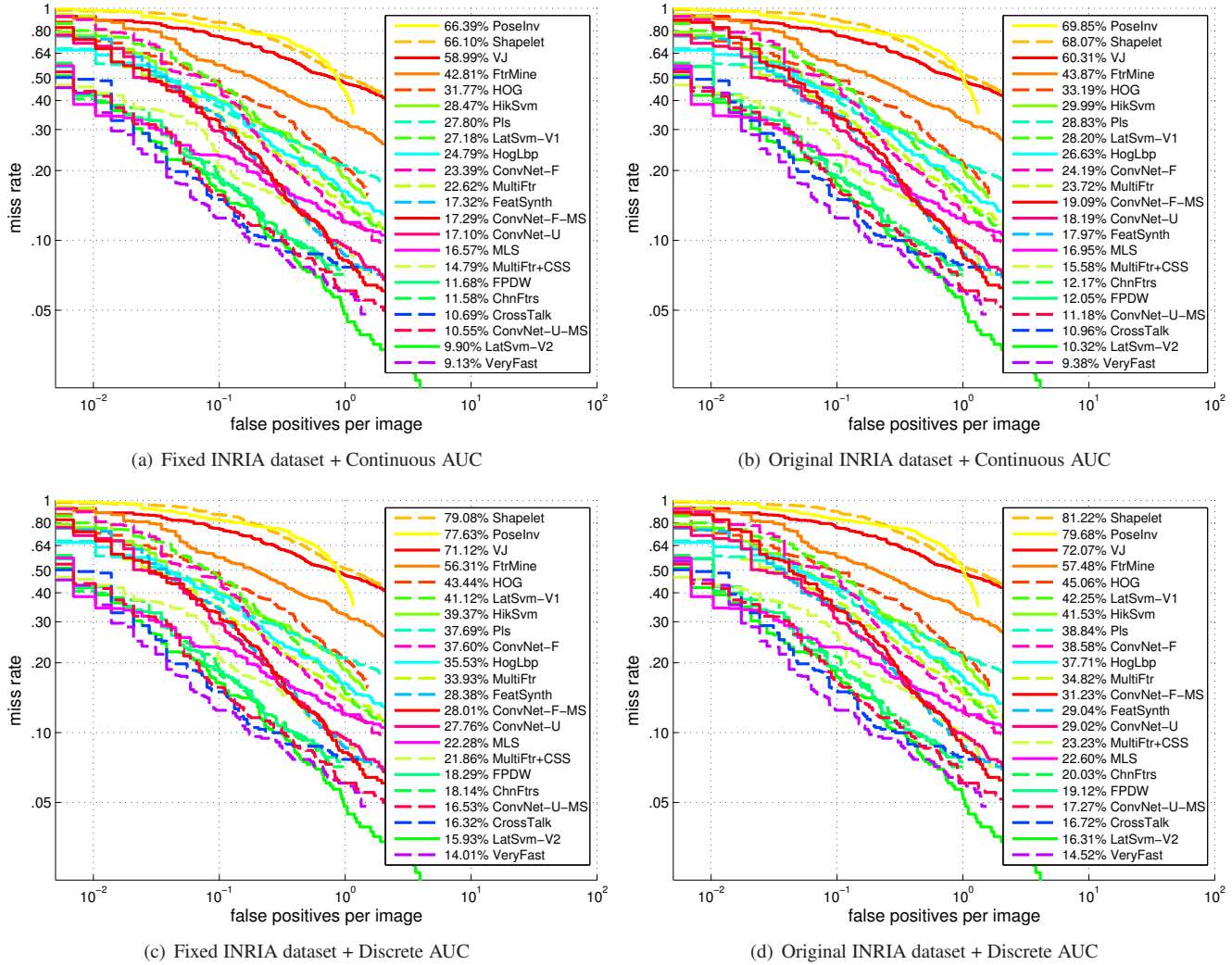


Figure 3: **Effects of fixing INRIA dataset and AUC computation on results.** In 3(d), we report the original results obtained with the INRIA dataset and the Area Under Curve (AUC) as computed by the benchmarking software available at http://www.vision.caltech.edu/Image_Datasets/CaltechPedestrians. In 3(c), we use the fixed INRIA dataset instead of the original and observe the re-ranking of several algorithms (ChnFtrs, MLS and ConvNet-F-MS advance by one rank). In 3(b), we use the continuous AUC computation instead of the discrete one and observe the following re-ranking: MultiFtr+CSS, FeatSynth, Convnet-F advance by one rank while LatSvm-V1 by two. In 3(a), we use both the fixed INRIA and the continuous AUC and observe the following re-ranking as opposed to the unmodified 3(d) ranks: ConvNet-U-MS, FPDW, MLS, FeathSynth, Convnet-F, and Shapelet advance by one while LatSvm-V1 by two. **Note:** the fixed INRIA dataset and the modified benchmark software are available at <http://cs.nyu.edu/~sermanet/data.html>.

3. All results with the continuous AUC measure

Trained on	INRIA												TUD-MotionPairs				Caltech									
	ChnFirs	ComNet-F	ComNet-E-MS	ComNet-U	ComNet-U-MS	CrossTalk	FPDW	FeatSynth	FRMLine	HOG	HISym-V2	LatSvm-V1	LatSvm-V1	HogLbp	LatSvm-V1	MLS	MultiFtr	Pis	Poselm	Shapenet	VJ	VeryFast	MultiFtr+CSS	MultiFtr+Motion	MultiResC	
INRIA-fixed	13.3	26.7	19.5	19.8	12.0	12.7	13.6	19.0	43.8	32.9	29.9	26.2	28.8	12.9	17.8	24.2	29.0	66.7	66.8	59.4	10.3	16.1	16.9	16.1	-	-
INRIA	13.9	27.4	21.4	20.9	12.7	12.9	14.0	19.6	44.8	34.3	31.4	28.0	29.8	13.3	18.2	25.3	30.1	70.1	68.7	60.7	10.5	16.9	16.9	16.9	-	-
Damier	-	-	-	-	58.6	-	-	-	67.9	62.4	69.8	-	64.2	62.3	51.8	68.8	-	-	94.9	94.8	-	-	48.6	40.5	-	-
ETH	48.7	-	-	-	47.1	43.8	51.5	-	54.9	61.6	51.1	69.1	69.1	49.3	42.8	51.7	47.4	86.5	85.6	84.5	46.9	58.2	47.9	58.2	-	-
Caltech-UsaTest	77.1	-	-	-	90.9	77.8	78.1	78.1	86.7	85.5	86.8	87.9	91.7	84.2	83.4	83.4	92.6	95.4	95.4	99.1	92.7	-	81.2	77.9	74.2	-
TudBrussels	57.6	-	-	-	66.8	55.0	59.0	-	73.6	76.4	77.2	85.7	87.2	67.2	59.2	70.5	66.1	83.8	93.8	99.1	-	57.8	51.4	-	-	
INRIA-fixed	13.3	26.7	19.5	19.8	12.0	12.7	13.6	19.0	43.8	32.9	29.9	26.2	28.8	12.9	17.8	24.2	29.0	66.7	66.8	59.4	10.3	16.1	16.9	16.1	-	-
INRIA	13.9	27.4	21.4	20.9	12.7	12.9	14.0	19.6	44.8	34.3	31.4	28.0	29.8	13.3	18.2	25.3	30.1	70.1	68.7	60.7	10.5	16.9	16.9	16.9	-	-
Damier	-	-	-	-	24.9	-	-	-	46.2	38.9	40.3	47.2	47.2	29.2	18.3	45.5	-	85.2	83.9	83.6	42.5	29.0	23.3	23.3	-	-
ETH	44.2	-	-	-	38.9	39.1	46.8	-	51.1	59.2	43.7	66.6	66.6	41.1	37.1	47.5	42.2	85.2	85.9	83.6	42.5	49.4	47.9	47.9	-	-
Caltech-UsaTest	46.4	-	-	-	71.5	46.0	46.9	49.2	66.3	57.8	62.0	62.2	73.4	56.0	51.9	59.3	52.9	78.2	87.0	91.8	-	52.1	42.3	38.1	-	-
TudBrussels	48.8	-	-	-	59.1	47.0	50.4	-	68.1	72.4	71.8	84.0	84.0	59.6	52.0	64.8	59.1	80.8	92.5	91.1	-	50.2	43.8	-	-	-
INRIA-fixed	11.6	23.4	17.3	17.1	10.5	10.7	11.7	17.3	42.8	31.8	28.5	24.8	27.2	0.9	16.6	23.6	27.8	66.4	66.1	59.0	9.1	14.8	14.8	14.8	-	-
INRIA	12.2	24.2	19.1	18.2	11.2	11.0	12.1	18.0	43.9	31.7	28.2	26.8	28.2	10.3	17.9	23.7	28.8	69.9	68.1	60.3	9.4	15.0	15.0	15.0	-	-
Damier	-	-	-	-	7.8	-	-	-	31.7	28.2	11.8	22.9	22.9	6.9	13.9	30.9	26.6	63.9	75.8	76.7	24.4	18.7	18.6	18.6	-	-
ETH	30.2	-	-	-	24.4	28.2	33.4	-	33.1	36.4	29.5	47.6	47.6	26.8	24.8	35.1	26.6	63.9	75.8	76.7	24.4	36.7	31.6	31.6	-	-
Caltech-UsaTest	24.1	-	-	-	14.8	25.8	26.4	28.6	47.8	28.0	26.5	18.4	40.7	22.5	22.7	34.3	30.4	54.5	69.6	80.9	-	28.8	12.0	12.5	-	-
TudBrussels	36.2	-	-	-	33.5	37.3	35.0	-	-	56.2	52.2	46.3	64.5	43.1	41.8	55.5	43.3	70.0	80.3	86.0	-	45.3	38.1	-	-	-
INRIA-fixed	11.6	24.5	18.6	17.7	11.3	11.0	11.9	17.3	42.6	31.5	28.5	24.7	27.5	11.1	16.5	23.7	27.7	66.0	66.1	58.7	9.7	14.7	14.7	14.7	-	-
INRIA	12.2	25.3	20.5	18.8	11.9	11.2	12.3	17.9	43.7	32.9	30.0	26.5	28.5	11.5	16.8	23.8	28.8	69.4	68.1	60.0	9.9	15.5	15.5	15.5	-	-
Damier	-	-	-	-	10.0	-	-	-	36.8	30.4	10.9	27.6	27.6	10.8	14.7	33.7	-	78.3	86.3	-	-	18.4	19.5	-	-	-
ETH	35.2	-	-	-	28.9	30.9	37.5	-	40.5	45.6	31.7	52.2	52.2	31.4	29.5	39.4	34.1	80.6	79.9	80.0	29.8	40.0	36.3	36.3	-	-
Caltech-UsaTest	27.4	-	-	-	27.3	28.9	28.4	29.5	48.9	33.1	34.3	24.7	47.2	26.7	29.1	40.8	31.2	66.8	75.7	85.3	-	30.4	16.4	15.0	-	-
TudBrussels	39.5	-	-	-	40.4	40.3	38.8	-	-	61.1	58.7	50.5	70.9	47.1	45.3	57.2	49.6	80.0	85.6	89.0	-	46.5	39.8	-	-	-
INRIA-fixed	100.0	10.4	32.3	31.9	33.2	99.7	100.0	100.0	100.0	100.0	100.0	85.3	85.3	99.7	100.0	86.1	100.0	99.7	99.7	91.5	27.9	91.3	91.3	91.3	-	-
INRIA	100.0	10.4	32.3	31.9	33.2	99.7	100.0	100.0	100.0	100.0	100.0	85.3	85.3	99.7	100.0	86.1	100.0	99.7	99.7	91.5	27.9	91.3	91.3	91.3	-	-
Damier	-	-	-	-	54.2	-	-	-	62.1	54.4	70.7	58.5	58.5	60.0	44.7	63.2	-	95.2	93.7	-	-	43.4	34.0	-	-	-
ETH	42.9	-	-	-	55.4	42.1	45.4	-	49.9	54.7	61.2	71.5	71.5	57.3	43.9	47.3	45.0	73.9	74.5	71.2	48.3	55.2	54.7	-	-	
Caltech-UsaTest	69.5	-	-	-	92.2	70.6	70.6	70.2	82.1	81.4	82.6	91.5	91.1	80.8	80.6	77.8	75.8	88.8	94.7	98.7	-	76.0	73.4	65.4	-	-
TudBrussels	57.4	-	-	-	67.8	55.5	59.7	-	71.4	74.9	82.9	85.5	85.5	68.2	59.1	68.7	65.0	79.4	94.1	91.7	-	55.0	48.6	-	-	-
Caltech-UsaTest	93.4	-	-	-	100.0	95.4	94.2	94.7	95.0	96.2	98.2	100.0	97.8	97.4	100.0	95.9	98.7	100.0	99.9	99.3	-	95.3	94.6	100.0	-	-
Caltech-UsaTest	61.3	-	-	-	81.9	69.2	66.9	67.0	81.6	77.1	80.3	75.0	84.1	76.7	71.3	78.6	68.1	85.7	90.5	96.9	-	76.6	64.4	61.3	-	-
Caltech-UsaTest	91.3	-	-	-	96.3	90.7	91.8	87.8	95.3	93.7	93.2	95.6	94.4	93.3	92.1	95.0	92.3	97.2	97.3	98.2	-	91.1	87.8	84.0	-	-
Caltech-UsaTest	57.3	-	-	-	74.5	55.4	61.9	60.3	76.8	75.3	77.4	77.2	85.8	70.8	71.5	73.3	69.1	86.0	92.1	93.6	-	64.3	48.9	50.6	-	-

Table 1: Results for all experiments on all datasets using the proposed continuous AUC. The top performing results (INRIA-trained only) are highlighted in bold for each row. The continuous AUC percentage is taken over the range [0,1] from DET curves. DET curves plot false positives per image (FPI) against miss rate. Hence a smaller AUC% means a more accurate system with greater reduction of false positives.

4. All results with the original discrete AUC measure

Trained on	INRIA										TUDD-MotionPairs										Coltech					
	ChaFirs	ComNet-F	ComNet-E-MIS	ComNet-U	ComNet-U-MIS	CrossTalk	FPDW	FeatSynth	FrMinc	HOG	HISem	HogLbp	LatSvm-V1	LatSvm-V2	MIS	MultiFtr	Pls	Posiwin	Shapenet	VJ	VeryFast	MultiFtr+CSS	MultiFtr+Motion	MultiFtr+Rec		
INRIA-fixed	20.2	41.7	30.5	31.5	18.7	18.6	20.6	30.3	57.2	43.0	36.9	42.9	19.6	23.6	35.6	39.0	77.9	79.6	71.6	15.8	23.3	-	-	-	-	
INRIA	22.2	42.2	34.2	32.6	19.8	19.0	21.5	30.9	58.3	46.0	39.1	43.8	20.0	23.9	36.5	40.1	80.1	81.7	72.5	16.0	24.7	-	-	-	-	
Damier	-	-	-	-	64.5	-	-	-	67.3	74.3	74.8	72.2	68.3	60.2	76.6	59.8	92.8	90.7	96.8	96.7	48.1	58.2	-	-	-	
ETH	61.9	-	-	-	57.8	56.5	64.3	-	67.4	73.8	61.7	78.6	58.3	54.9	63.6	59.8	92.8	92.0	90.4	90.4	59.3	70.7	-	-	-	
Coltech-UsaTest	82.8	-	-	-	92.9	83.7	84.1	-	90.6	90.4	91.4	89.8	87.7	87.2	87.8	85.7	95.5	97.0	99.5	99.5	85.5	82.8	-	-	-	
TudBrussels	67.7	-	-	-	74.9	65.1	70.1	-	81.8	85.3	85.4	91.3	75.6	69.0	78.1	76.2	90.0	96.2	95.5	-	66.5	62.0	-	-	-	
INRIA-fixed	20.2	41.7	30.5	31.5	18.7	18.6	20.6	30.3	57.2	44.4	40.7	42.9	19.6	23.6	35.6	39.0	77.9	79.6	71.6	15.8	23.3	-	-	-	-	
INRIA	22.2	42.2	34.2	32.6	19.8	19.0	21.5	30.9	58.3	46.0	42.8	43.8	20.0	23.9	36.5	40.1	80.1	81.7	72.5	16.0	24.7	-	-	-	-	
Damier	-	-	-	-	32.5	-	-	-	59.8	55.0	48.7	57.6	38.0	27.6	57.2	-	-	95.8	94.7	-	39.2	29.2	-	-	-	
ETH	57.5	-	-	-	50.3	51.9	60.1	-	64.2	72.0	55.2	76.7	50.9	49.4	59.8	54.9	92.1	90.9	89.9	54.8	60.7	60.0	-	-	-	
Coltech-UsaTest	56.3	-	-	-	77.2	53.9	57.4	60.2	74.4	68.5	73.4	67.8	63.3	61.0	68.3	62.1	86.3	91.4	94.7	-	60.9	50.9	-	-	-	
TudBrussels	60.3	-	-	-	68.8	58.0	63.0	-	77.9	82.5	81.7	90.2	69.6	62.6	73.4	70.7	88.0	95.4	94.5	-	59.5	54.8	-	-	-	
INRIA-fixed	18.1	37.6	28.0	27.8	16.5	16.3	18.3	28.4	56.3	43.4	39.4	35.5	15.9	22.2	33.9	37.7	77.6	79.1	71.1	14.0	21.9	-	-	-	-	
INRIA	20.0	38.6	31.2	29.0	17.3	16.7	19.1	29.0	57.5	45.1	41.5	37.7	16.3	22.6	34.8	38.8	79.7	81.2	72.1	14.5	23.2	-	-	-	-	
Damier	-	-	-	-	11.6	-	-	-	47.4	40.5	17.0	32.8	10.6	20.6	43.4	-	-	81.6	89.6	-	23.7	21.4	-	-	-	
ETH	42.4	-	-	-	34.6	37.5	46.4	-	44.2	49.4	40.8	60.6	35.3	33.9	46.0	37.3	77.1	84.8	84.8	35.1	46.5	40.3	-	-	-	
Coltech-UsaTest	30.2	-	-	-	21.4	29.8	33.4	36.2	59.1	57.9	39.0	22.7	28.2	31.1	43.0	36.5	71.6	76.6	86.2	-	36.3	35.9	-	-	-	
TudBrussels	43.1	-	-	-	41.1	45.2	44.1	-	71.2	67.6	59.3	76.6	54.2	51.6	65.5	54.3	82.3	87.1	91.9	-	54.9	46.5	-	-	-	
INRIA-fixed	18.3	38.7	29.4	28.3	17.7	16.7	18.7	28.3	56.2	43.1	39.3	35.4	17.5	22.2	34.1	37.7	77.4	79.1	70.9	14.9	21.7	-	-	-	-	
INRIA	20.2	39.8	35.2	29.4	18.8	17.1	19.5	28.9	57.3	44.7	41.3	37.6	17.9	22.5	35.0	38.8	79.5	81.3	71.9	15.1	23.2	-	-	-	-	
Damier	-	-	-	-	14.8	-	-	-	47.4	40.5	17.0	32.8	10.6	20.6	43.4	-	-	81.6	89.6	-	23.7	21.4	-	-	-	
ETH	48.3	-	-	-	39.3	42.1	50.7	-	53.5	59.2	43.0	64.7	40.1	40.0	50.3	46.0	89.1	88.0	87.2	41.1	45.0	48.6	-	-	-	
Coltech-UsaTest	35.1	-	-	-	36.7	34.3	36.7	38.9	58.4	44.0	48.0	30.8	34.3	37.7	50.0	39.8	77.9	82.9	89.9	-	38.8	38.8	-	-	-	
TudBrussels	49.6	-	-	-	49.9	49.7	50.0	-	73.5	73.0	64.3	81.3	58.0	55.2	66.3	61.6	88.0	90.9	93.0	-	56.3	50.1	-	-	-	
INRIA-fixed	100.0	0.0	44.7	48.3	45.8	100.0	100.0	100.0	100.0	100.0	100.0	92.3	88.8	100.0	100.0	100.0	100.0	100.0	100.0	92.6	39.0	91.7	-	-	-	
INRIA	100.0	0.0	44.7	48.3	45.8	100.0	100.0	100.0	100.0	100.0	100.0	92.3	88.8	100.0	100.0	100.0	100.0	100.0	100.0	92.6	39.0	91.7	-	-	-	
Damier	-	-	-	-	60.7	-	-	-	72.8	68.0	75.0	67.8	67.1	53.9	72.2	-	-	97.0	96.1	-	53.5	41.2	-	-	-	
ETH	53.6	-	-	-	65.7	53.0	56.0	-	59.8	67.6	70.3	80.3	67.1	54.2	58.0	55.9	85.0	82.6	80.6	60.5	67.5	67.8	-	-		
Coltech-UsaTest	77.4	-	-	-	94.9	77.4	78.4	78.2	87.3	87.4	88.5	93.0	85.5	85.5	84.1	82.0	93.1	96.7	99.4	-	82.1	80.1	-	-	-	
TudBrussels	67.7	-	-	-	76.5	64.9	70.6	-	79.4	84.4	90.2	91.1	77.2	69.2	76.7	75.7	86.8	96.5	94.7	-	63.8	58.1	-	-	-	
Coltech-UsaTest	95.2	-	-	-	100.0	96.6	95.7	96.4	96.9	97.1	99.1	100.0	98.5	97.9	100.0	96.9	99.2	100.0	99.9	99.7	-	96.7	96.8	-	-	-
Coltech-UsaTest	73.0	-	-	-	87.1	76.1	77.6	75.8	88.3	84.5	88.3	79.9	81.3	79.7	85.9	75.0	92.3	93.5	98.7	-	81.4	73.0	-	-	-	
Coltech-UsaTest	94.8	-	-	-	97.6	93.7	95.6	92.9	97.7	96.0	95.3	96.7	95.3	94.7	94.8	98.3	98.3	98.3	98.8	-	93.7	92.6	-	-	-	
Coltech-UsaTest	67.7	-	-	-	81.1	64.3	72.4	71.7	85.6	85.1	86.2	83.4	89.7	77.4	79.5	82.4	77.8	91.9	95.0	96.7	-	74.1	57.1	-	-	-

Table 2: Results for all experiments using the discrete AUC. This table is identical to table 1 except it is using the discrete AUC instead of the proposed continuous AUC.