## 1 Supplementary materials

In Table S-1 is reported a comparison between the fuzzy adaptive binarizations of  $A_2$  -  $CF_{1,2}$ ,  $A_3$  - Hamacher and  $A_4$  - Choquet and the Bradley algorithm on the toy dataset.

Table S-1: Fuzzy adaptive binarizations - compatrisons between Bradley and out algorithms.

			Image a				ompau				
	$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I_{F_{A_2}}^*}$			1.0	0.0	100	100	$\frac{100}{100}$				
$I_B$	4	0.42	0.16	0.45	21.6	100	35.56				
$I_{A_3}$		0.01	0.51	0.16	44.4	100	61.54				
$I_B$	4	0.01	0.44	0.19	40	100	57.14				
$I_{A_4}$			0.33	0.28	30.77	100	47.06				
$I_B$	2	0.06	0.33	0.28	30.77	100	47.06				
Image <b>b</b> with $\gamma_0, \gamma_3$ .											
	$n_a$	t	$\widetilde{\text{SSIM}}$	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I_{F_{A_2}}^*}$		0.01	1.0	0.0	100	100	100				
$I_B$	4	0.01	0.45	0.16	41.18	100	58.33				
$\mathbf{I}^*_{\mathbf{F_{A_3}}}$	4	0.01	1.0	0.0	100.00	100	100				
$I_B$	4	0.01	0.45	0.16	41.18	100	58.33				
$I_{A_4}$	2	0.01	0.58	0.11	50	100	66.67				
$I_B$	2	0.01	0.47	0.19	36.84	100	53.85				
	Image <b>c</b> with $\gamma_0, \gamma_1$ .										
	$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I_{F_{A_2}}^*}$	4	0.5	1.0	0.0	100	100	100				
$I_B$	4	0.0	0.18	0.49	24.14	100	38.89				
$\mathbf{I}^*_{\mathbf{F_{A_3}}}$	4	0.01	1.0	0.0	100.00	100	100				
$I_B$	1	0.01	0.97	0.02	87.5	100	93.33				
$I_{F_{A_4}}$	1	0.01	0.88	0.12	56	100	71.79				
$I_B$	1		0.85	0.1	60.87	100	75.68				
	Image <b>d</b> with $\gamma_1, \gamma_4$ .										
	$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I}^*_{\mathbf{F}_{\mathbf{A_2}}}$	4	0.5	1.0	0.0	100	100	100				
$I_B$	1		0.29	0.22	33.33	100	50				
$I_{F_{A_3}}$	2	0.01	0.39	0.19	36.84	100	53.85				
$I_B$			0.39	0.17	38.89	100	56.0				
$I_{F_{A_4}}$	1	0.01	0.43	0.19	36.84	100	53.85				
$I_B$			0.15	0.42	20.59	100	34.15				
	Image <b>e</b> with $\gamma_0, \gamma_1$ .										
	$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I}^*_{\mathbf{A_2}}$	4	0.58	1.0	0.0	100	100	100				
$I_B$	-1	0.00	0.66	0.19	71.43	100	83.33				
$\mathbf{I}^*_{\mathbf{A_3}}$	4	0.06	1.0	0.0	100	100	100				
$I_{\mathrm{B}}$			1.0	0.0	100	100	100				
$I_{F_{A_4}}$	4	0.01	1.0	0.0	100	100	100				
$I_B$			0.96	0.02	100	96.67	98.31				

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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	image i with $\gamma_0, \gamma_1, \gamma_3$ .											
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\mathbf{I}^*_{\mathbf{A_2}}$	4	0.58		0.0	100		100				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$I_B$			0.07	0.69	26.32	100	41.67				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\mathbf{I}^*_{\mathbf{A_3}}$	4	0.06	1.0	0.0	100	100	100				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$I_B$			0.97	0.01	95.24	100	97.56				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\mathbf{I}^*_{\mathbf{A}_4}$	1	0.01	1.0	0.0	100	100	100				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$I_{\mathbf{B}}$	4	0.01	1.0	0.0	100	100	100				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$												
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\mathbf{I}_{\mathbf{A}_2}^*$	4	0.55	1.0	0.0	100	100	100				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$I_B$	4	0.55	0.04	0.73	21.67	100	35.62				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\mathbf{I}^*_{\mathbf{A}_3}$	4	0.01	1.0	0.0	100	100	100				
$I_B$ 0.07 0.02 92.86 100 96.3	$I_{\mathbf{B}}$	4	0.01	1.0	0.0	100	100	100				
$I_B$ 0.07 0.02 92.86 100 96.3	$I_{F_{A_{A}}}$	4	0.07	0.97	0.02	92.86	100	96.3				
	$I_B$						100	96.3				
Image <b>h</b> with $\gamma_0, \gamma_1$ .												
$n_a$ $t$ SSIM MSE $P_m$ $R_m$ $F_m$		$n_a$	t	SSIM	MSE	$P_m$	$R_m$	$F_m$				
$\mathbf{I_{A_2}^*}$ 4 0.58 1.0 0.0 100 100 100	$\mathbf{I}^*_{\mathbf{A}_2}$	4	0.58	1.0	0.0	100	100	100				
$I_B$ 0.66 0.19 71.43 100 83.33	$I_B$	4	0.56	0.66	0.19	71.43	100	83.33				
$\mathbf{I_{A_3}^*}$ 4 0.08 1.0 0.0 100 100 100	$\mathbf{I}^*_{\mathbf{A_3}}$	4	0.08	1.0	0.0	100	100	100				
$\mathbf{I_B}$ 4 0.08 1.0 0.0 100 100 100	$I_{\mathbf{B}}$			1.0	0.0	100	100	100				
$\mathbf{I}_{\mathbf{A_4}}^*$	$\mathbf{I}_{\mathbf{A}_{4}}^{*}$	4	0.01	1.0	0.0	100	100	100				
$I_B$ 4 0.01 0.96 0.02 100 96.67 98.31	$I_B$			0.96	0.02	100	96.67	98.31				