Introduction of Color Toolbox FGLT: simple, fast, free, effective & diverse for everybody in color calculation (scientific exchange - no commercial)

® Dr. - Ing. Vinh Trinh – Fachgebiet Lichttechnik – TU Darmstadt - Germany

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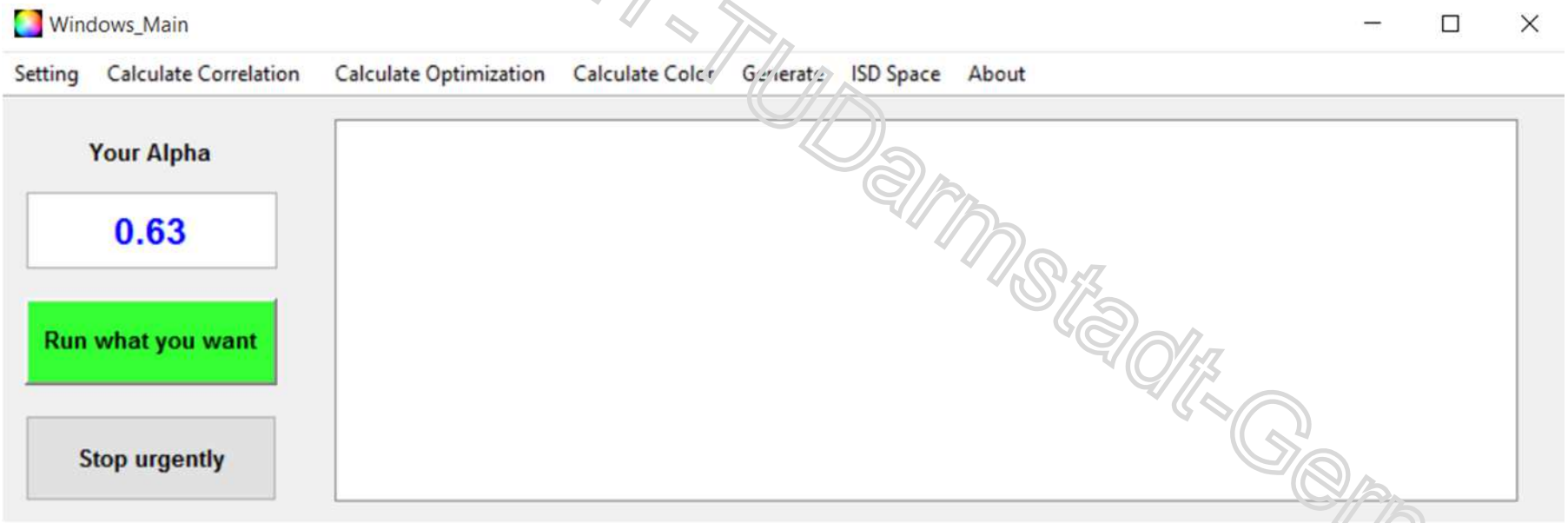

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4. Mode "*Calculation correlation*": find 2D & 3D correlations as SPSS
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6. Mode "*Calculate Color*": calculate all color difference, Chroma difference, represent correct test color sample with their true color under different light sources
7. Mode "*Generate*": generate standard spectra, locus of Mac Adam-Ellipse, spectra of semiconductor LED and phosphors
8. Mode "ISD Space": read, arrange and save ISD data from spectrometers

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1- Motivation

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How to evaluate color quality of spectra?

How to evaluate and represent color objects?

How to find correlations like SPSS?

How to have 1-2..MacAdam-Ellipse for desired CCT or xy?

How to read, arrange & save ISD data from spectrometer?

How to optimize the color quality?

How to generate standard light sources with desired CCTs?

How to generate spectra of semiconductor LEDs?

How to generate spectral emission of phosphors?

I can't work with .csv & others, but only Excel or txt?

I need for my research/study - not for commercial.

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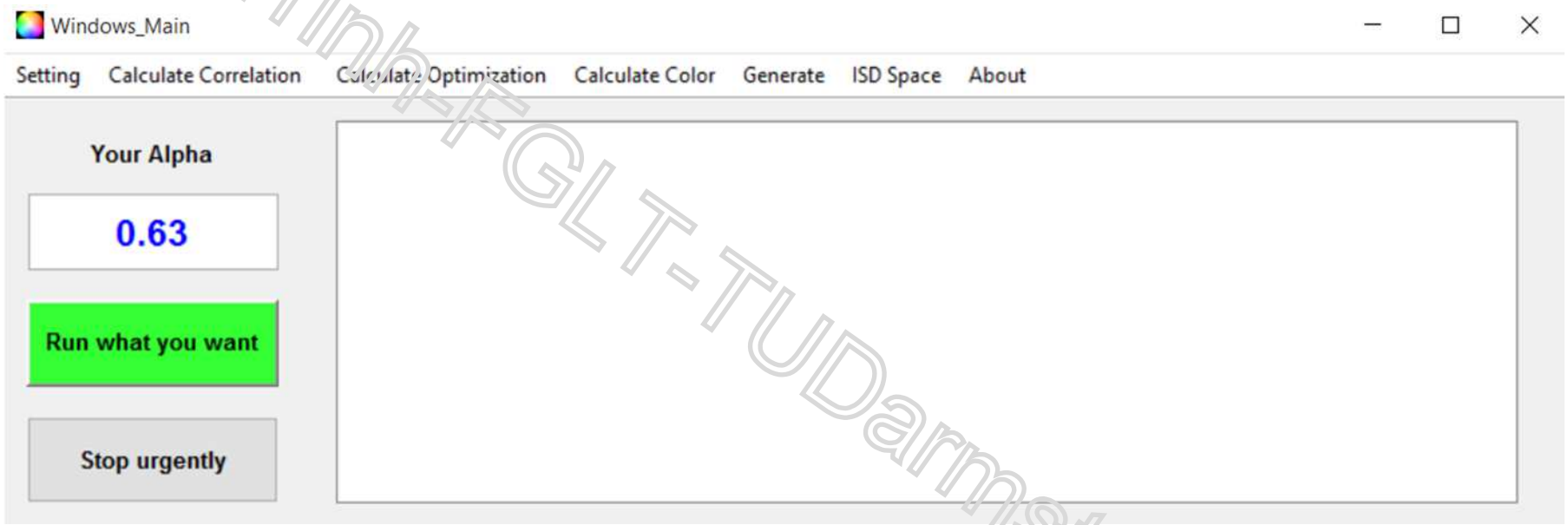
1- Motivation



Color Toolbox FGLT will help you!

But only for scientific exchanges - not for commercial.

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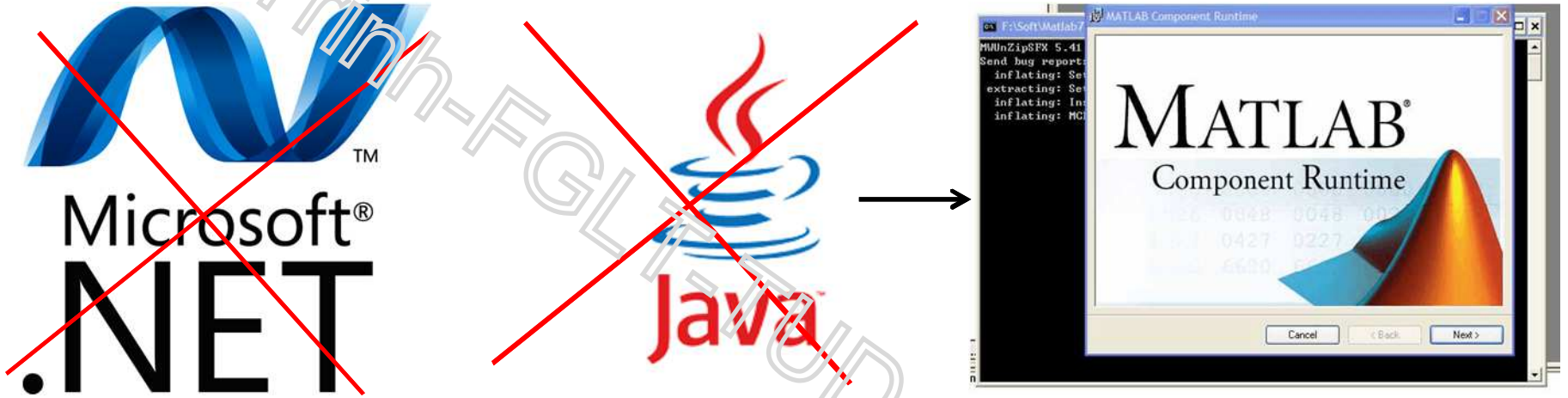
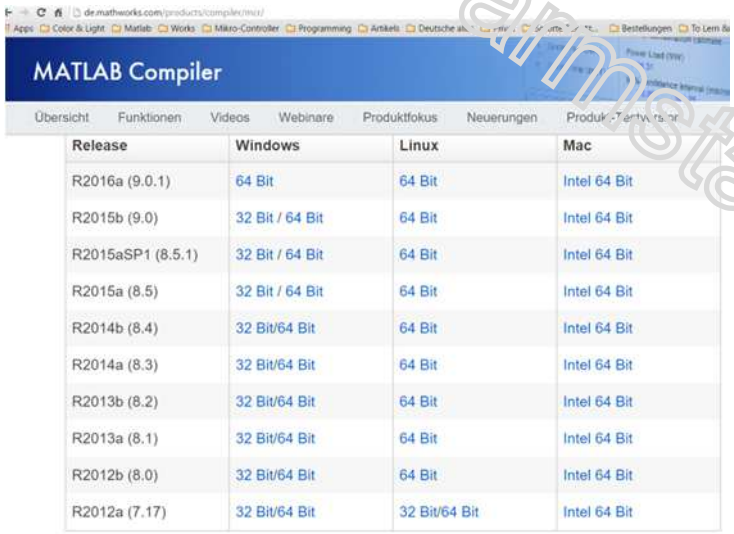
2- Installation

you need a MCR Matlab as runtime like Java, .Net & Setup file





Release	Windows	Linux	Mac
R2016a (9.0.1)	64 Bit	64 Bit	Intel 64 Bit
R2015b (9.0)	32 Bit / 64 Bit	64 Bit	Intel 64 Bit
R2015aSP1 (8.5.1)	32 Bit / 64 Bit	64 Bit	Intel 64 Bit
R2015a (8.5)	32 Bit / 64 Bit	64 Bit	Intel 64 Bit
R2014b (8.4)	32 Bit/64 Bit	64 Bit	Intel 64 Bit
R2014a (8.3)	32 Bit/64 Bit	64 Bit	Intel 64 Bit
R2013b (8.2)	32 Bit/64 Bit	64 Bit	Intel 64 Bit
R2013a (8.1)	32 Bit/64 Bit	64 Bit	Intel 64 Bit
R2012b (8.0)	32 Bit/64 Bit	64 Bit	Intel 64 Bit
R2012a (7.17)	32 Bit/64 Bit	32 Bit/64 Bit	Intel 64 Bit

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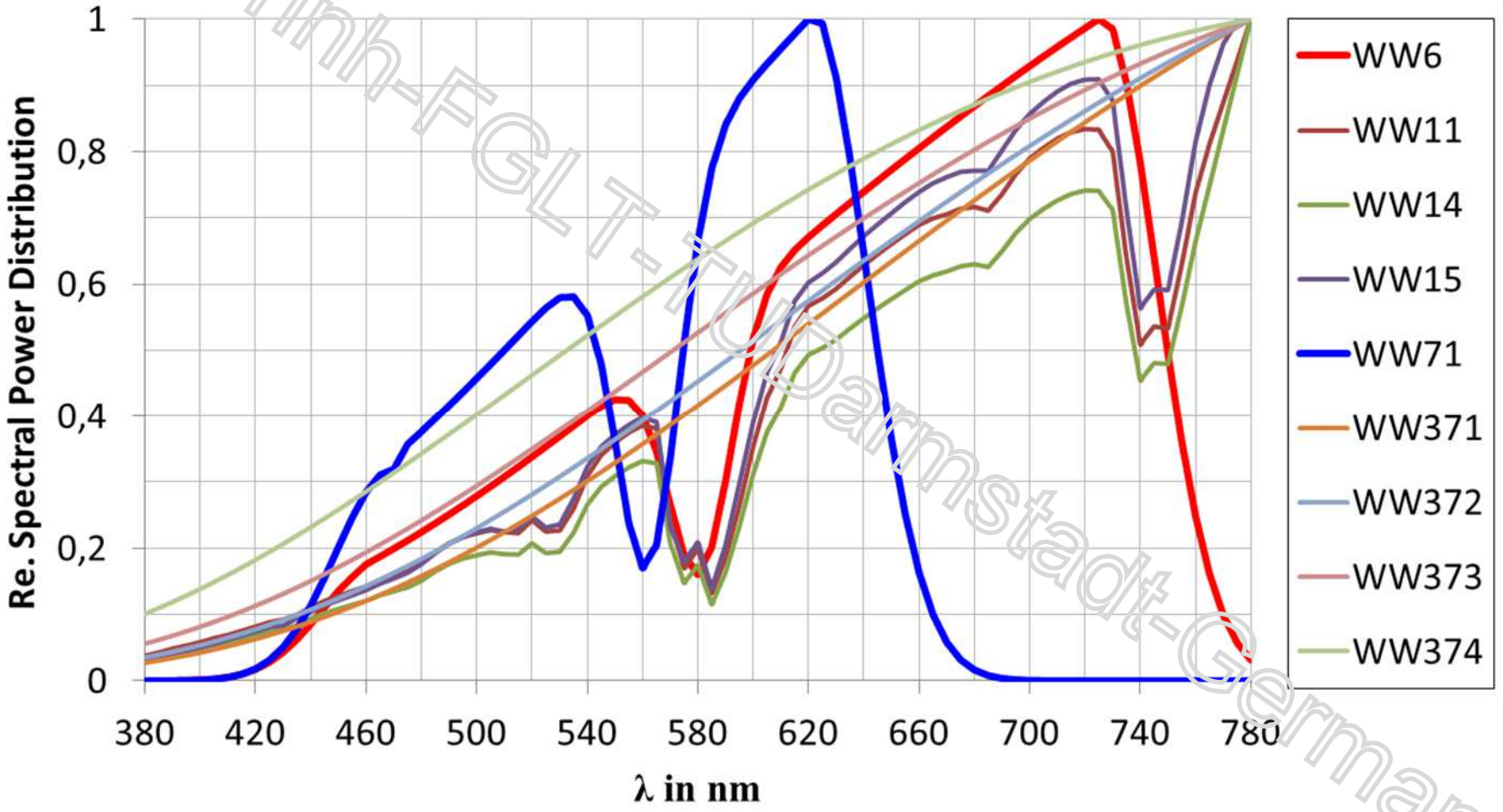
3- Main Mode "*Run what you want*"

Import, analysis & evaluate your spectra



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3- Main Mode "*Run what you want*"

Import, analysis & evaluate your spectra

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Name	WW6	WW11	WW14	WW15	WW71	WW371	WW372	WW373	WW374
CCT	2887	2862	2826	2756	3003	2700	2800	3000	3300
DCCT	2,60E-04	3,28E-03	5,45E-03	4,82E-03	3,58E-05	2,91E-06	2,81E-06	2,64E-06	2,42E-06
R1	68,13	70,63	70,74	70,67	88,96	100	100	100	100
R2	85,45	87,19	87,06	86,94	86,24	100	100	100	100
R3	88,81	87,16	87,42	87,29	81,49	100	100	100	100
R4	67,62	71,95	71,92	71,44	85,29	100	100	100	100
R5	71,27	74,03	73,92	73,69	84,34	100	100	100	100
R6	81,50	86,66	86,36	85,85	68,81	100	100	100	100
R7	82,50	81,54	81,97	82,48	80,46	100	100	100	100
R8	59,47	54,86	55,64	57,07	73,27	100	100	100	100
R9	**21,29**	**9,65**	**11,54**	**15,07**	**46,95**	**100**	**100**	**100**	**100**
R10	74,22	78,93	78,69	78,71	87,56	100	100	100	100
R11	63,50	72,50	72,28	71,25	70,03	100	100	100	100
R12	76,41	76,34	75,74	75,53	62,09	100	100	100	100
R13	70,45	73,88	73,79	73,46	84,82	100	100	100	100
R14	92,03	91,14	91,29	91,15	90,32	100	100	100	100
Ra	**75,59**	**76,76**	**76,88**	**76,93**	**81,11**	**100**	**100**	**100**	**100**
R114	**71,62**	**72,61**	**72,74**	**72,93**	**76,49**	**100**	**100**	**100**	**100**
GAIt	**58,84**	**71,02**	**69,98**	**66,47**	**54,42**	**49,14**	**52,24**	**58,07**	**65,83**
GAIr	**50,20**	**62,39**	**61,57**	**58,41**	**52,21**	**49,14**	**52,24**	**58,07**	**65,83**
GAIrel	**117,21**	**113,83**	**113,66**	**113,80**	**104,23**	**100**	**100**	**100**	**100**
Qa	84,58	89,80	89,94	89,74	83,41	100	100	100	100
Qf	80,11	83,20	83,32	83,46	82,15	100	100	100	100
Qg	**106,92**	**114,10**	**114,32**	**113,89**	**93,93**	**100**	**100**	**100**	**100**
Qp	**89,79**	**102,25**	**102,53**	**101,89**	**73,05**	**87,83**	**88,78**	**90,33**	**91,98**
CRI2012a	87,26	91,26	91,40	91,55	79,09	100,00	100,00	100,00	100,00
Se2012	2,00	1,74	1,73	1,72	2,46	1,07	1,07	1,07	1,07
MCRIa	**91,52**	**93,21**	**93,10**	**92,73**	**86,31**	**89,26**	**89,59**	**90,05**	**90,45**
FCI	**142,52**	**144,82**	**145,02**	**145,17**	**113,20**	**123,72**	**122,97**	**121,37**	**118,92**
R_f	80,98	85,45	85,51	85,56	77,66	100	100	100	100
R_g	**103,15**	**108,78**	**108,88**	**108,57**	**92,66**	**100**	**100**	**100**	**100**

3- Main Mode "*Run what you want*"

Import, analysis & evaluate your spectra

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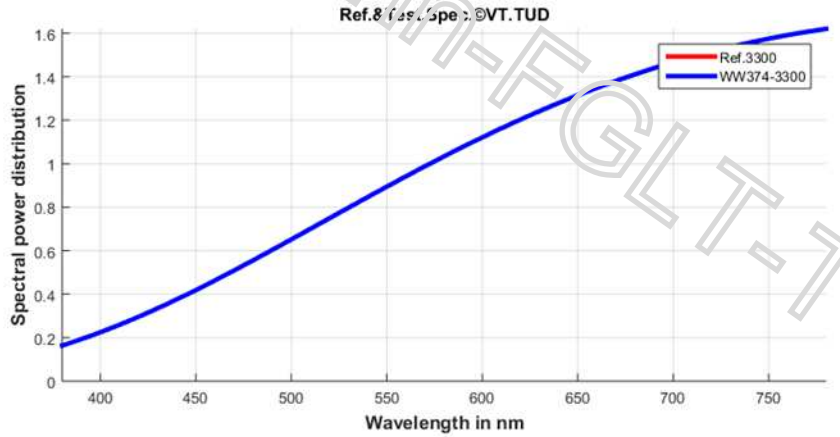

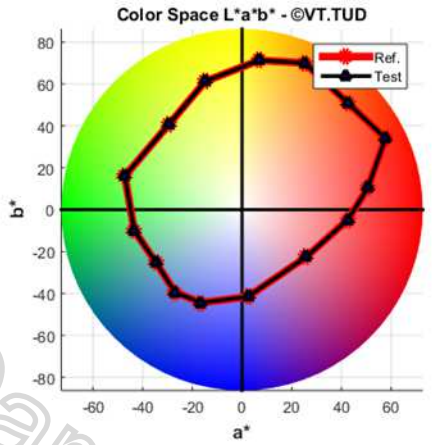

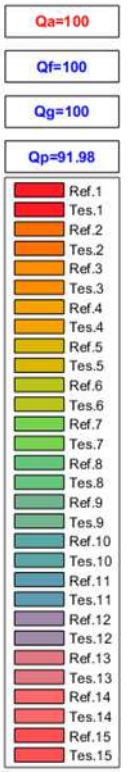

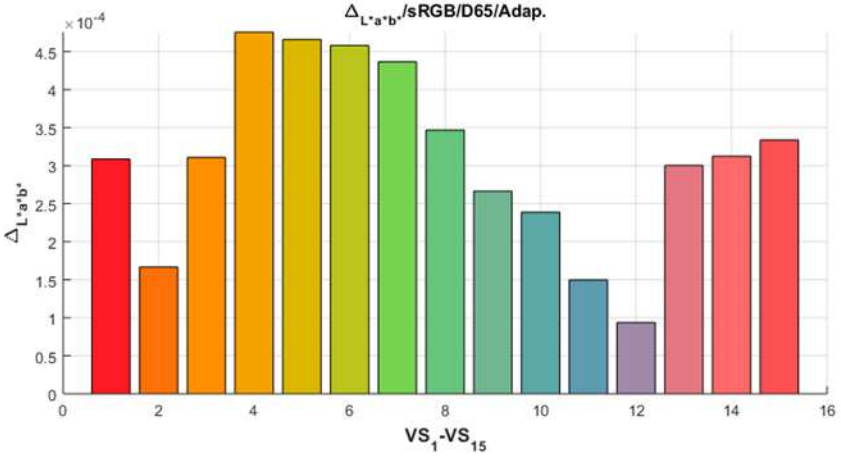

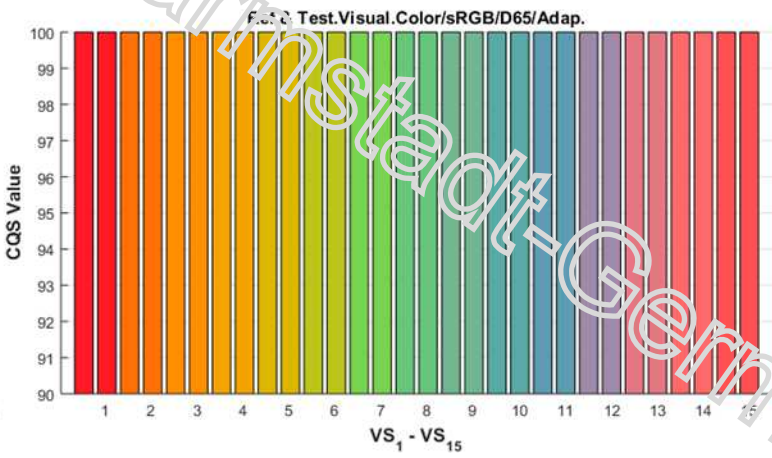

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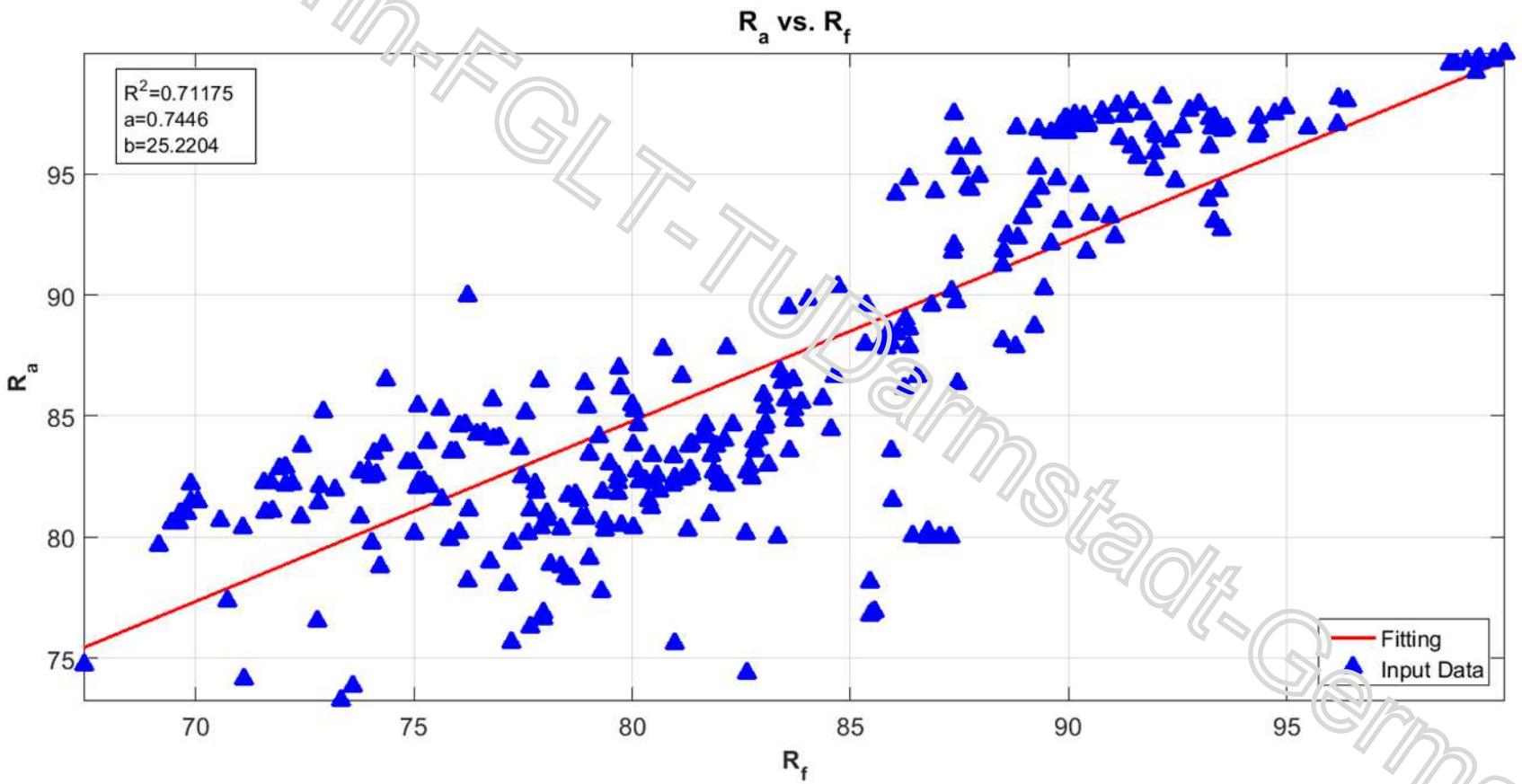
4- Sub-Mode 1 "*Calculation Correlation*"

a- 2D - Correlation



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4- Sub-Mode 1 "*Calculation Correlation*"

a- 2D - Correlation

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R^2	R_a	R_{114}	GAI_{abs}	GAI_{rel}	Q_a	Q_f	Q_g	Q_p	CRI_{2012}	*MCRI*	*Sa*	*FCI*	R_f	R_g
R_a	**1,00**	**0,93**	*0,00*	*0,11*	*0,38*	0,42	*0,00*	*0,33*	0,50	*0,33*	*0,32*	*0,09*	**0,71**	*0,00*
R_{114}	**0,93**	**1,00**	*0,02*	*0,16*	*0,43*	0,47	*0,00*	*0,39*	0,70	0,54	0,52	*0,16*	**0,85**	*0,00*
GAI_{abs}	*0,00*	*0,02*	**1,00**	*0,07*	*0,03*	*0,01*	*0,25*	*0,05*	*0,03*	*0,23*	*0,25*	*0,13*	*0,02*	*0,21*
GAI_{rel}	*0,11*	*0,16*	*0,07*	**1,00**	*0,09*	*0,05*	*0,45*	*0,27*	*0,09*	*0,31*	*0,38*	**0,76**	*0,16*	*0,21*
Q_a	*0,38*	0,43	*0,01*	*0,09*	**1,00**	**0,98**	*0,02*	**0,90**	0,43	*0,29*	*0,25*	*0,07*	0,52	*0,00*
Q_f	0,42	0,47	*0,01*	*0,05*	**0,98**	**1,00**	*0,00*	**0,83**	0,45	*0,27*	*0,24*	*0,04*	0,55	*0,00*
Q_g	*0,00*	*0,00*	*0,25*	0,45	*0,00*	*0,00*	**1,00**	*0,12*	*0,00*	*0,07*	*0,11*	0,60	*0,00*	**0,88**
Q_p	*0,33*	*0,39*	*0,05*	*0,27*	**0,90**	**0,83**	*0,12*	**1,00**	0,40	*0,36*	*0,35*	*0,26*	0,50	*0,08*
CRI_{2012}	0,50	0,70	*0,03*	*0,09*	0,43	0,45	*0,00*	0,40	**1,00**	0,64	0,60	*0,16*	**0,89**	*0,00*
MCRI	*0,33*	0,54	*0,23*	*0,31*	*0,29*	*0,27*	*0,07*	*0,36*	0,64	**1,00**	**0,98**	0,43	0,64	*0,02*
Sa	*0,32*	0,52	*0,25*	*0,38*	*0,25*	*0,24*	*0,11*	*0,35*	0,60	**0,98**	**1,00**	*0,33*	0,61	*0,04*
FCI	*0,09*	*0,16*	*0,13*	**0,76**	*0,07*	*0,04*	0,60	*0,26*	*0,16*	0,43	0,53	**1,00**	*0,18*	*0,36*
R_f	**0,71**	**0,85**	*0,02*	*0,16*	0,52	0,55	*0,00*	0,50	**0,89**	0,64	0,61	*0,18*	**1,00**	*0,00*
R_g	*0,00*	*0,00*	*0,21*	*0,21*	*0,00*	*0,00*	**0,88**	*0,08*	*0,00*	*0,02*	*0,04*	*0,36*	*0,00*	**1,00**

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4- Sub-Mode 1 "*Calculation Correlation*"

b- 3D Correlation

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MCRI-R^2	R_a	R_{114}	Q_f	CRI_{2012}	R_f
GAI_{abs}	0,53	0,69	0,51	0,76	0,78
GAI_{rel}	0,70	0,78	0,50	0,76	0,76
Q_g	0,56	0,72	0,46	0,72	0,73
FCI	0,65	0,78	0,60	0,79	0,79
R_g	0,50	0,67	0,50	0,71	0,72

MCRI-a	R_a	R_{114}	Q_f	CRI_{2012}	R_f
GAI_{abs}	-1,2E-03	-6,1E-04	6,5E-03	1,7E-05	1,2E-04
GAI_{rel}	4,4E-02	3,1E-02	1,0E-02	7,6E-03	1,6E-02
Q_g	4,7E-02	3,8E-02	3,7E-02	1,7E-02	2,4E-02
FCI	8,8E-03	8,9E-03	1,3E-03	2,2E-03	3,8E-03
R_g	5,6E-02	4,7E-02	6,8E-02	3,6E-02	4,0E-02

Q_p-R^2	R_a	R_{114}	Q_f	CRI_{2012}	R_f
GAI_{abs}	0,54	0,58	0,86	0,58	0,66
GAI_{rel}	0,49	0,49	0,94	0,54	0,57
Q_g	0,44	0,50	0,97	0,57	0,62
FCI	0,47	0,48	0,96	0,49	0,55
R_g	0,43	0,51	0,95	0,52	0,59

Q_p-a	R_a	R_{114}	Q_f	CRI_{2012}	R_f
GAI_{abs}	-1,8E-02	-1,7E-02	1,9E-03	-1,7E-02	-1,6E-02
GAI_{rel}	2,8E-02	1,2E-02	4,8E-03	-1,1E-02	-2,3E-04
Q_g	-1,9E-03	-1,3E-02	8,5E-03	-3,8E-02	-2,8E-02
FCI	6,2E-03	3,7E-03	1,9E-03	-3,7E-03	-7,3E-04
R_g	-2,7E-02	-3,9E-02	2,0E-02	-5,2E-02	-4,6E-02

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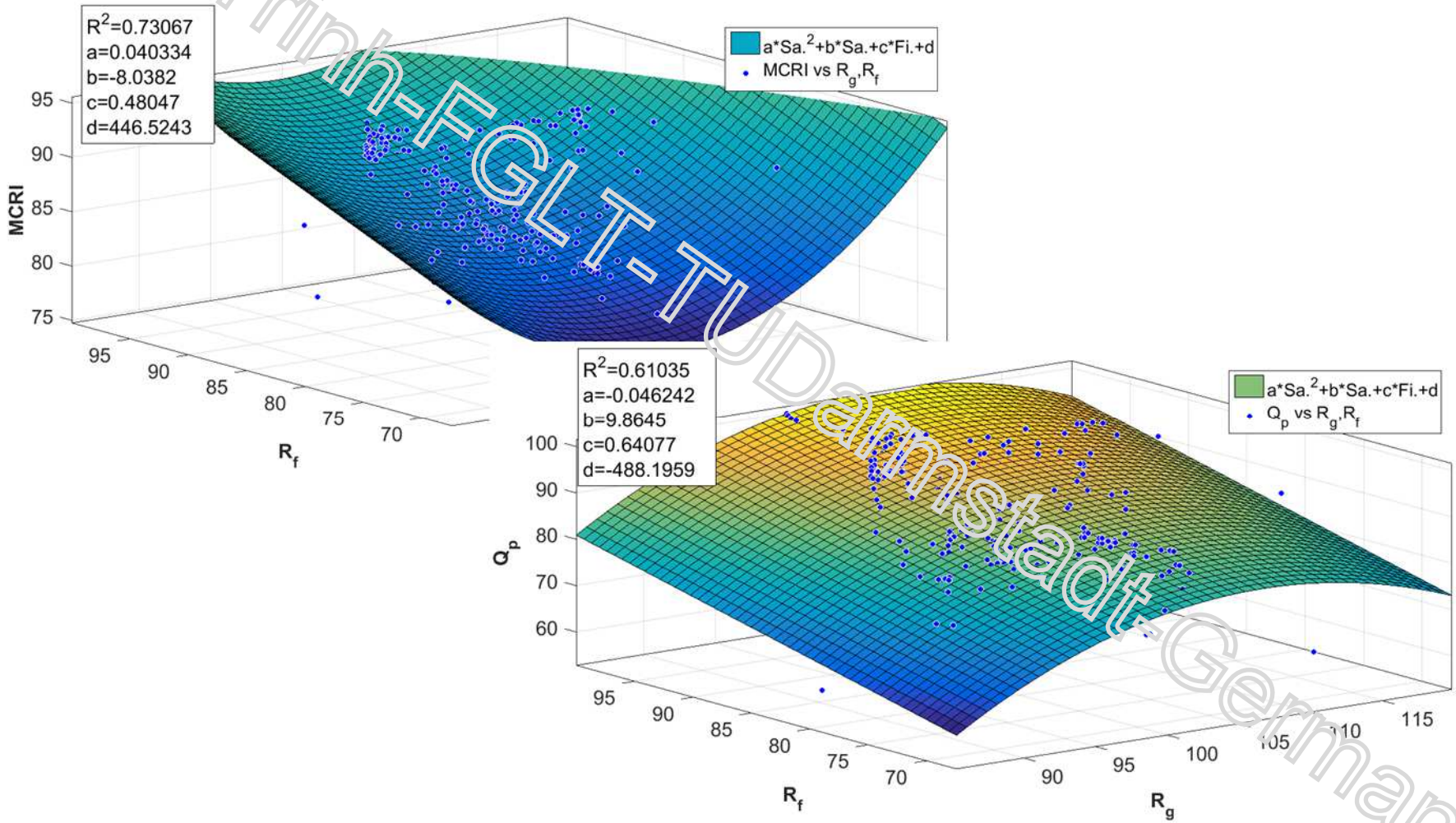
4- Sub-Mode 1 "*Calculation Correlation*"

b- 3D Correlation



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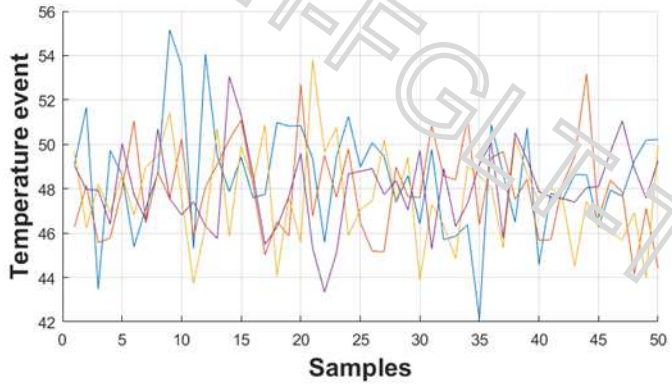
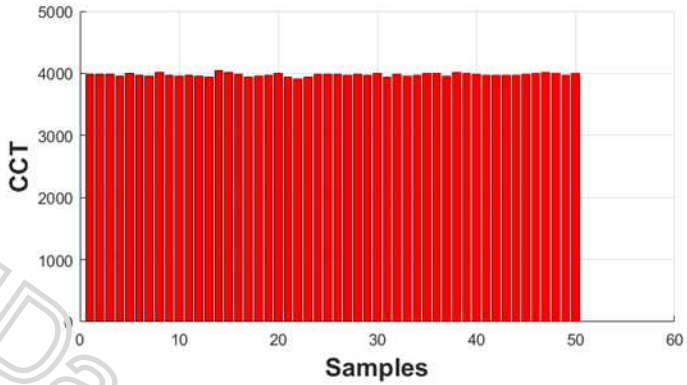
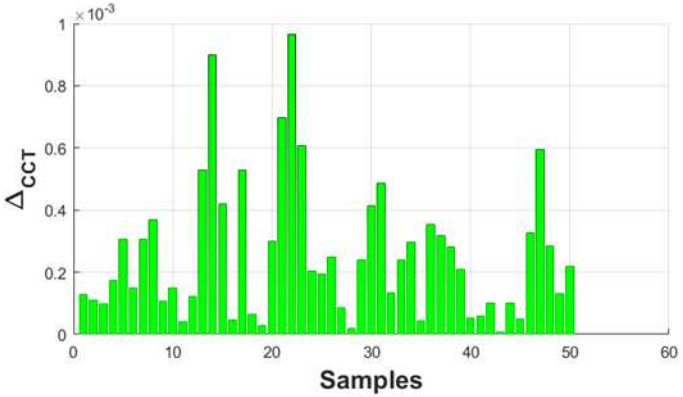
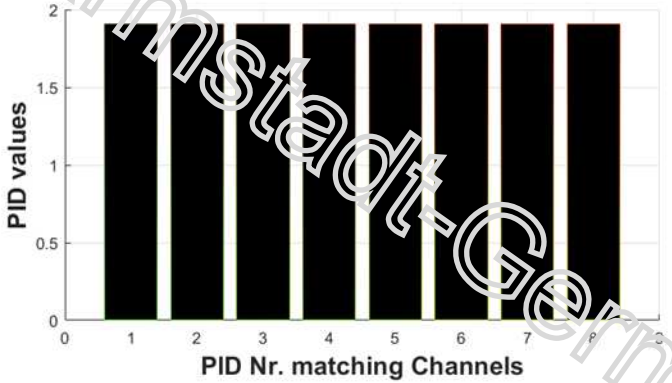
5- Sub-Mode 2 "*Calculate Optimization*"









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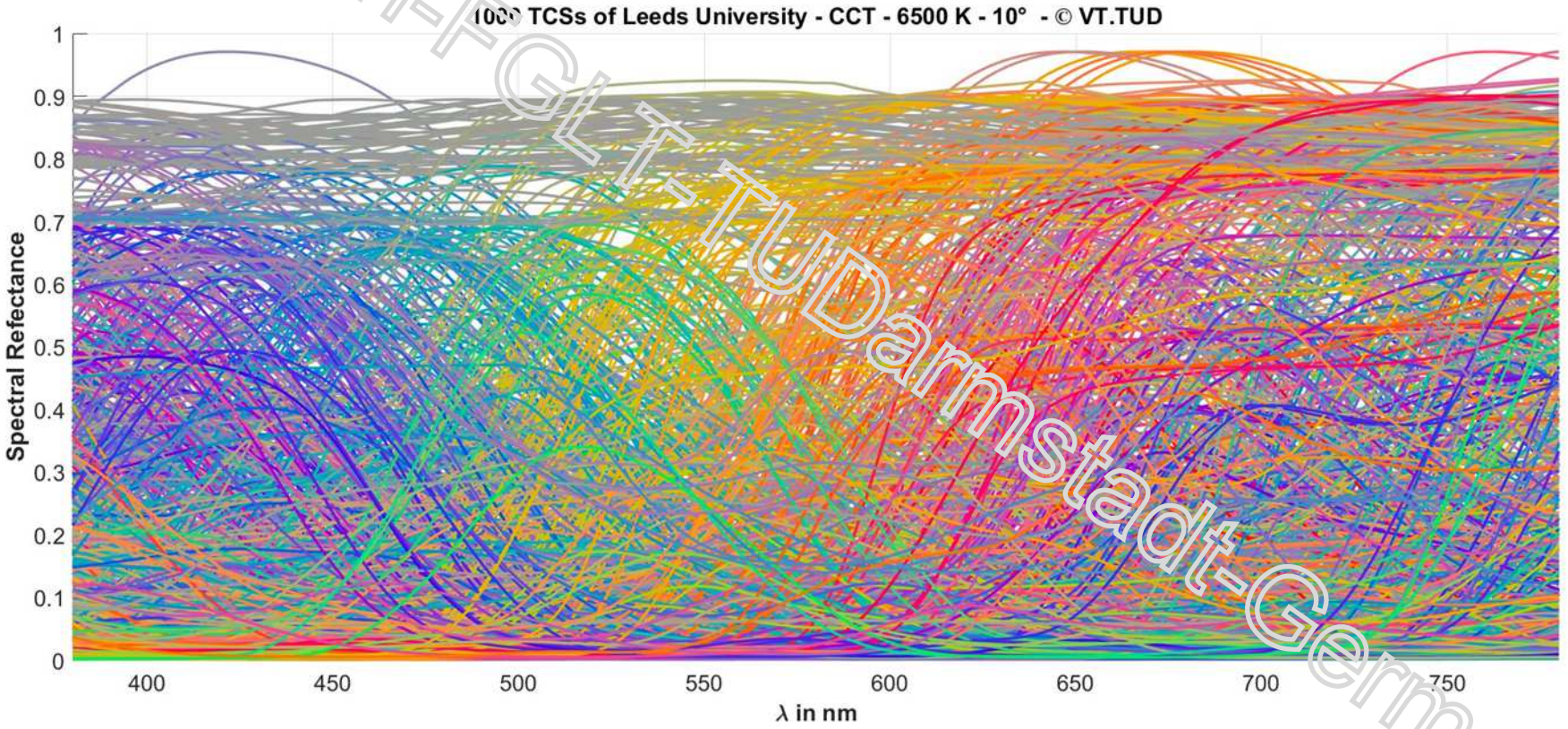
6- Sub-Mode 4 "*Calculate Color*"

a- Import TCSs & represent with their true colors



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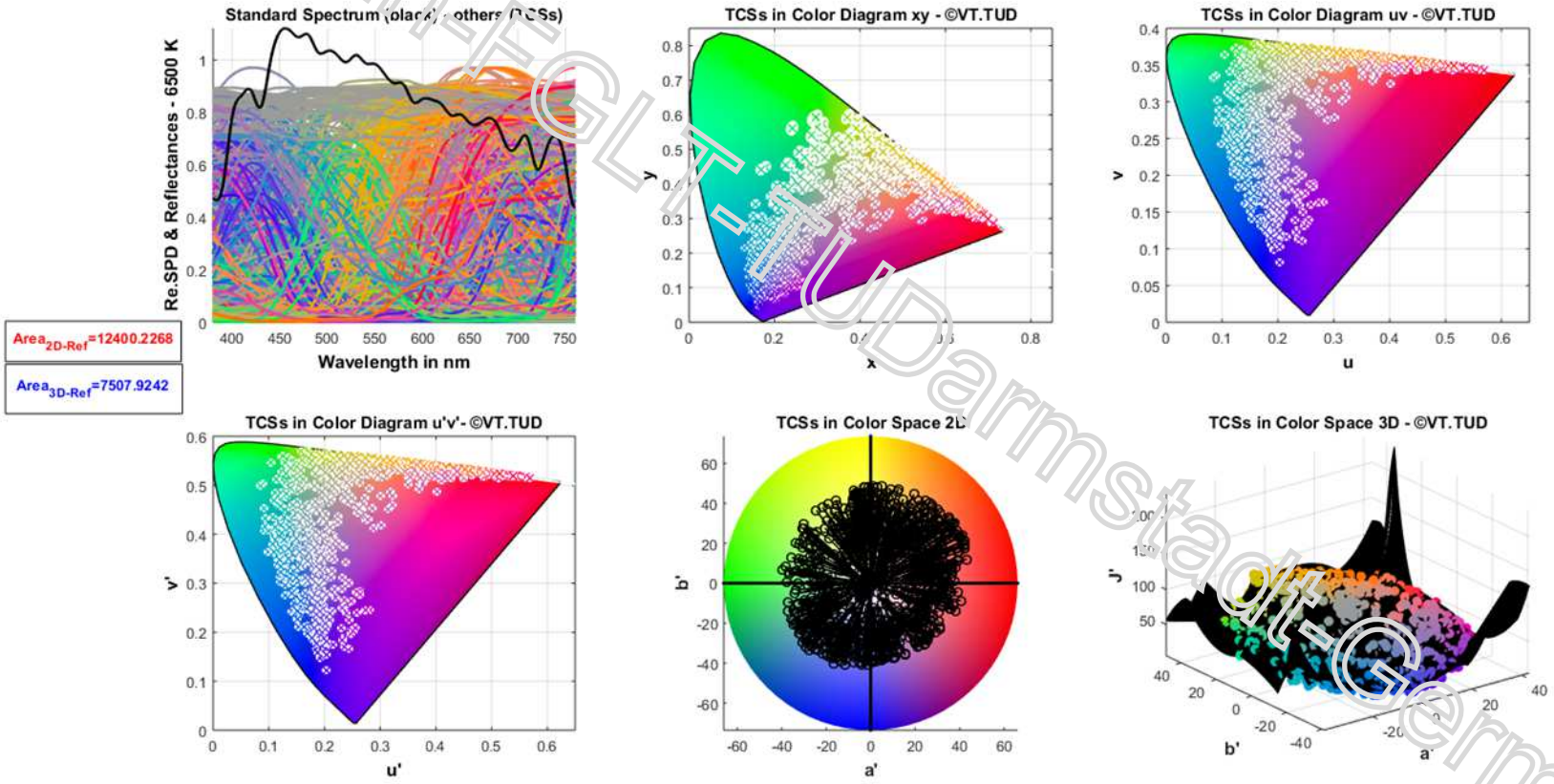
6- Sub-Mode 4 "*Calculate Color*"

b- Color Distribution in 2D - 3D Color diagram under different CCTs



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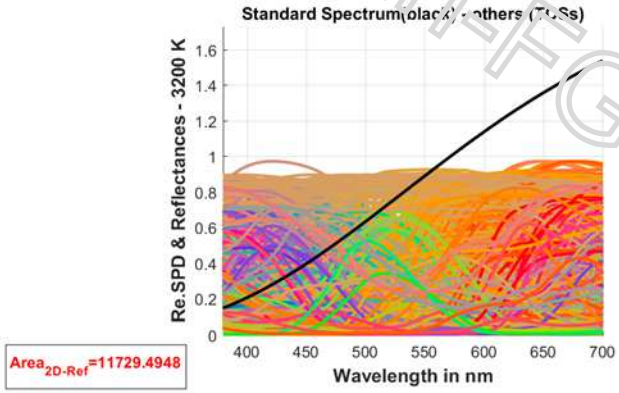
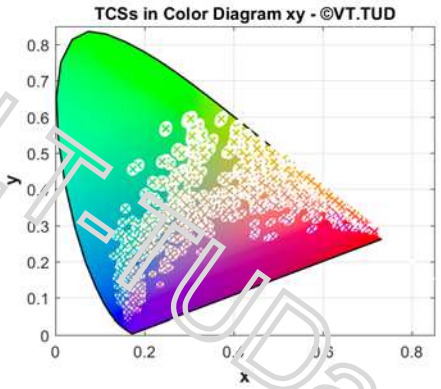
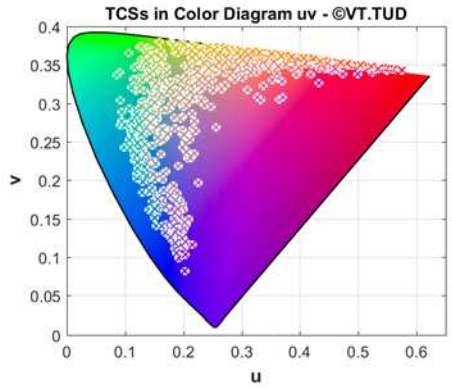
6- Sub-Mode 4 "*Calculate Color*"

b- Color Distribution in 2D - 3D Color diagram under different CCTs

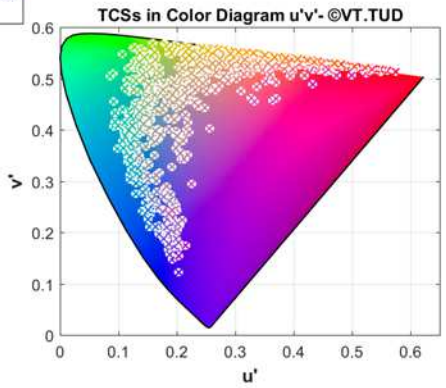


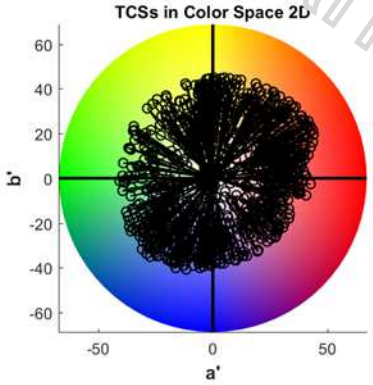


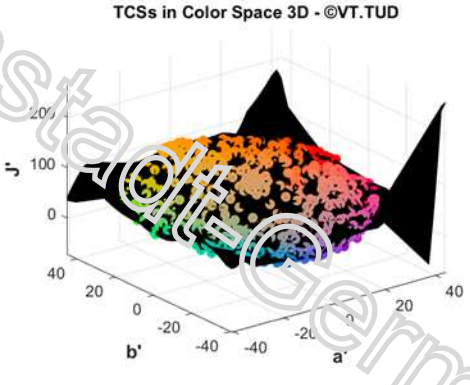


$Area_{2D\text{-}Ref}$=11729.4948

$Area_{3D\text{-}Ref}$=6607.3196







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6- Sub-Mode 4 "*Calculate Color*"

c- Calculate & represent hue & chroma difference under color spaces

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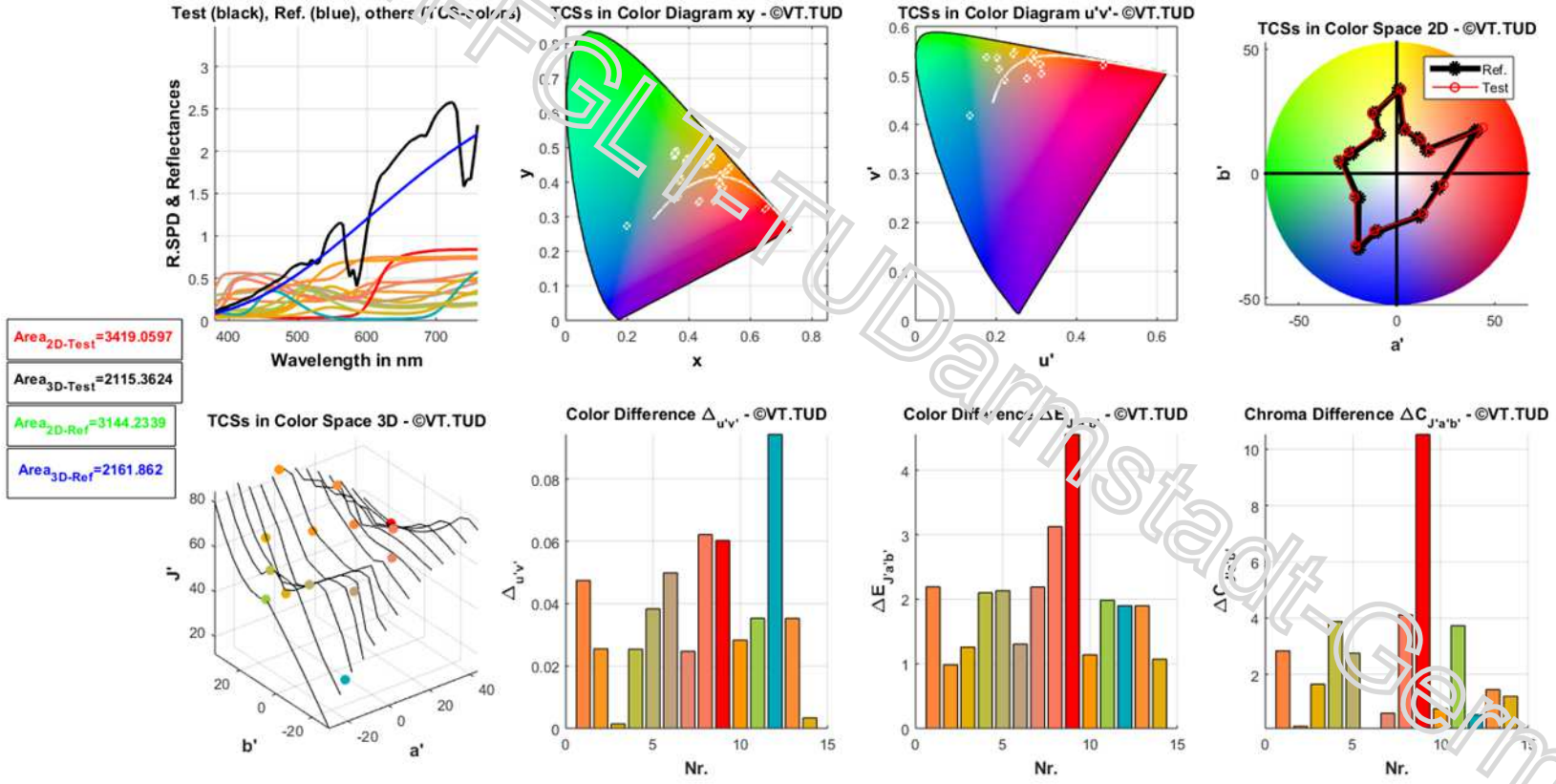
Color Space U*V*W* of CRI R1-14



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6- Sub-Mode 4 "*Calculate Color*"

c- Calculate & represent hue & chroma difference under color spaces

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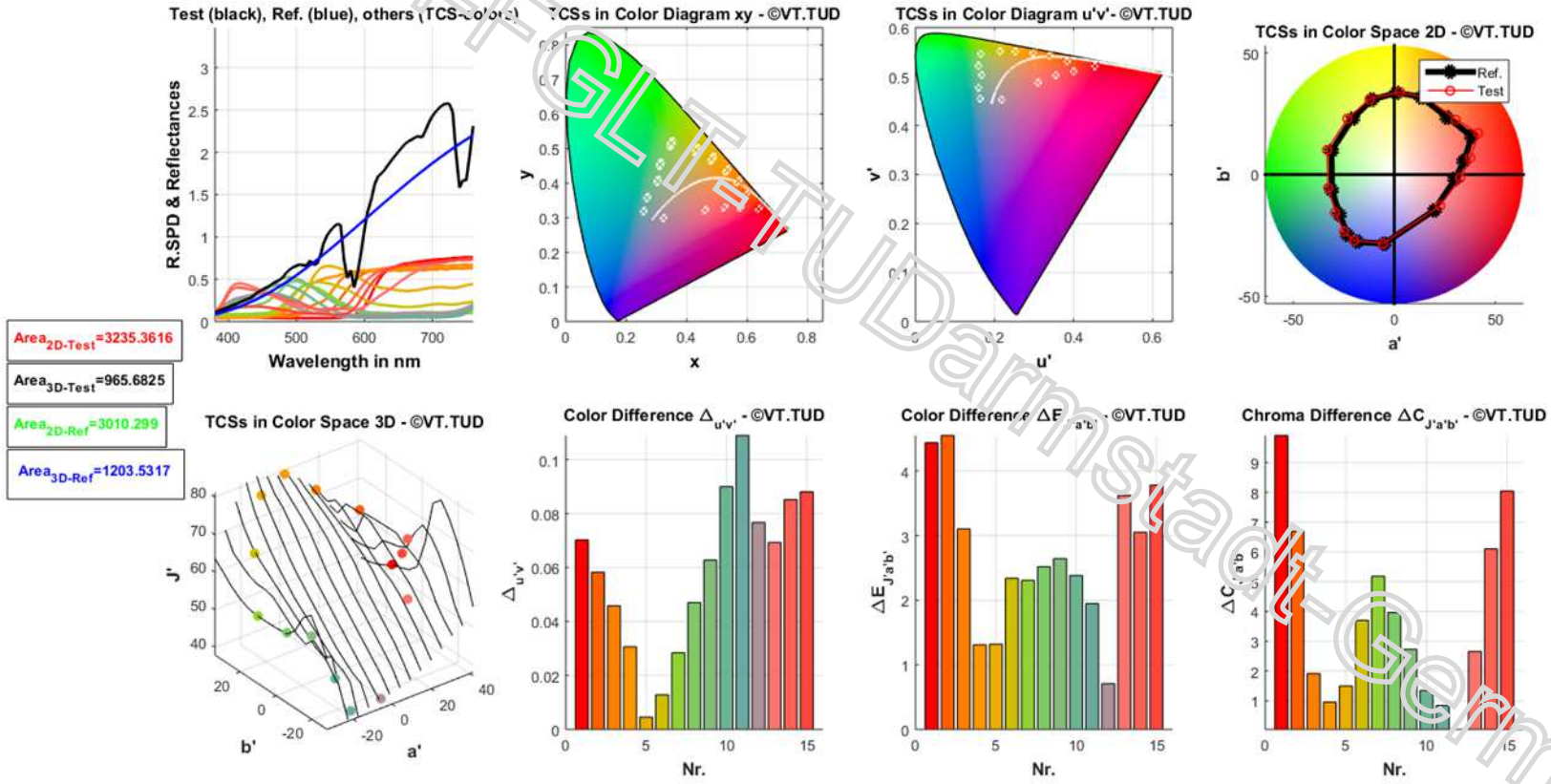
Color Space L*a*b* - CQS 1-15



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6- Sub-Mode 4 "*Calculate Color*"

c- Calculate & represent hue & chroma difference under color spaces

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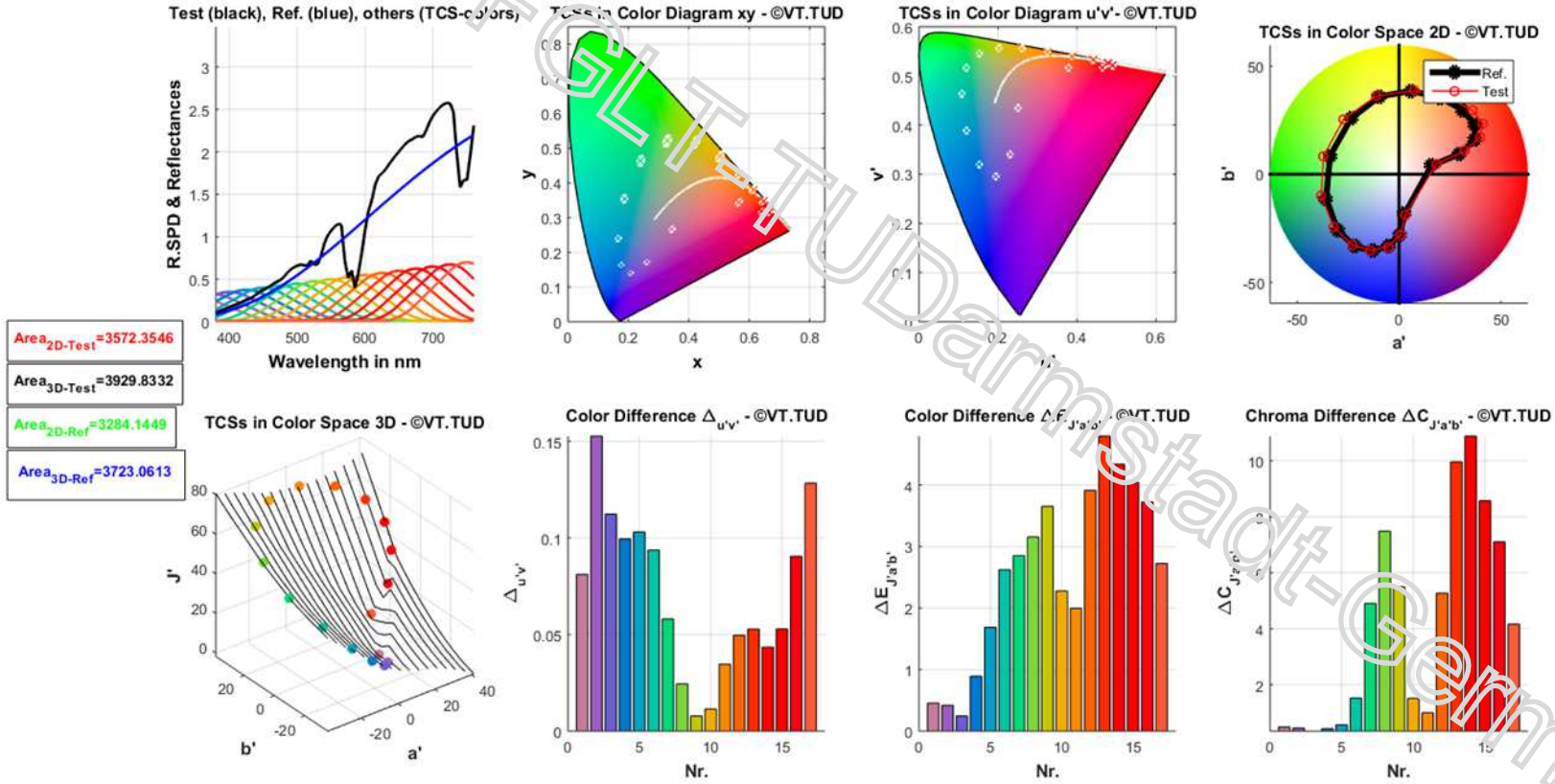
Color Space J'a'b' CRI2012



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6- Sub-Mode 4 "*Calculate Color*"

c- Calculate & represent hue & chroma difference under color spaces

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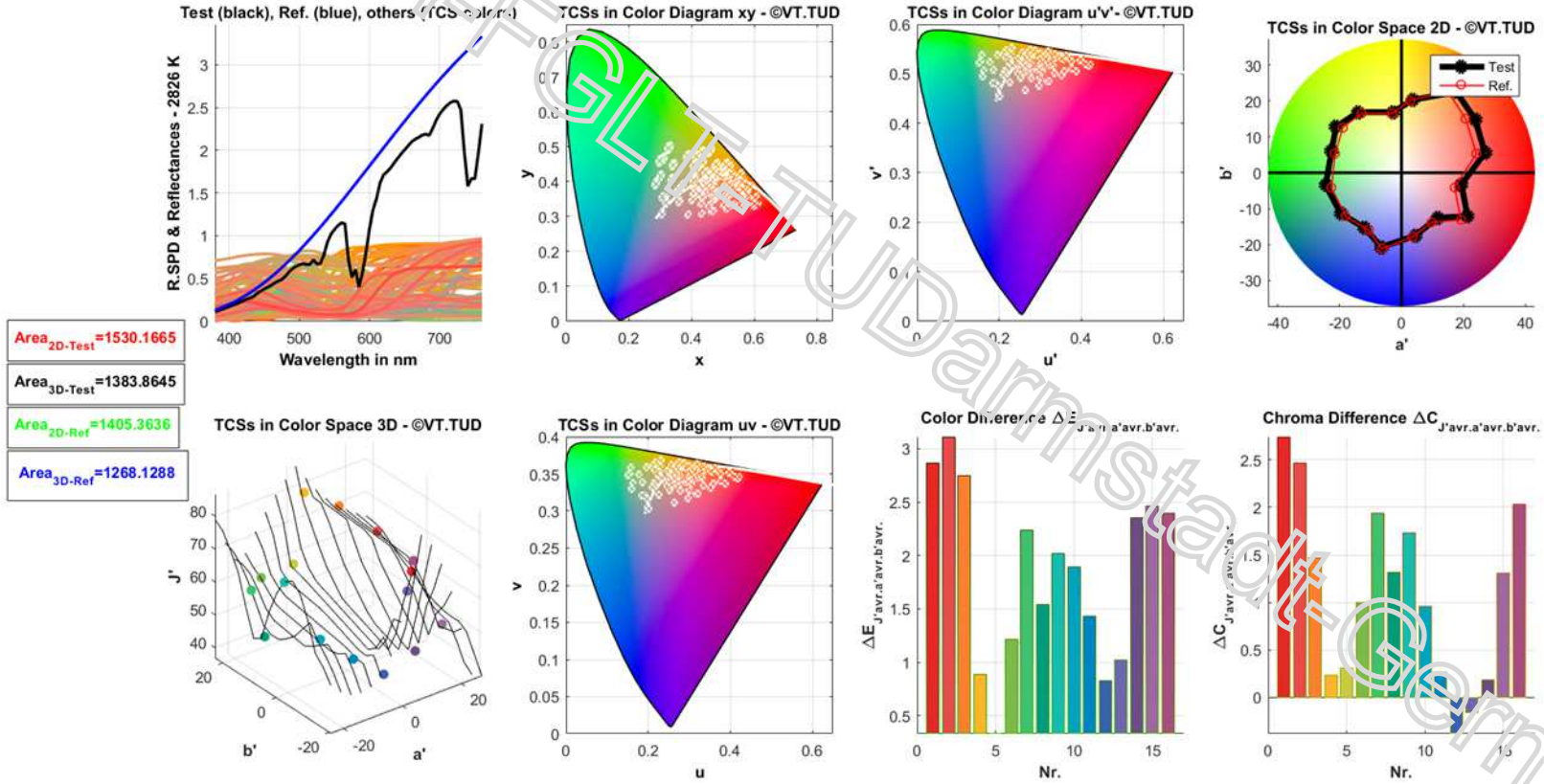
Color Space J'a'b' -- IES TM15-30 Bin 1-16



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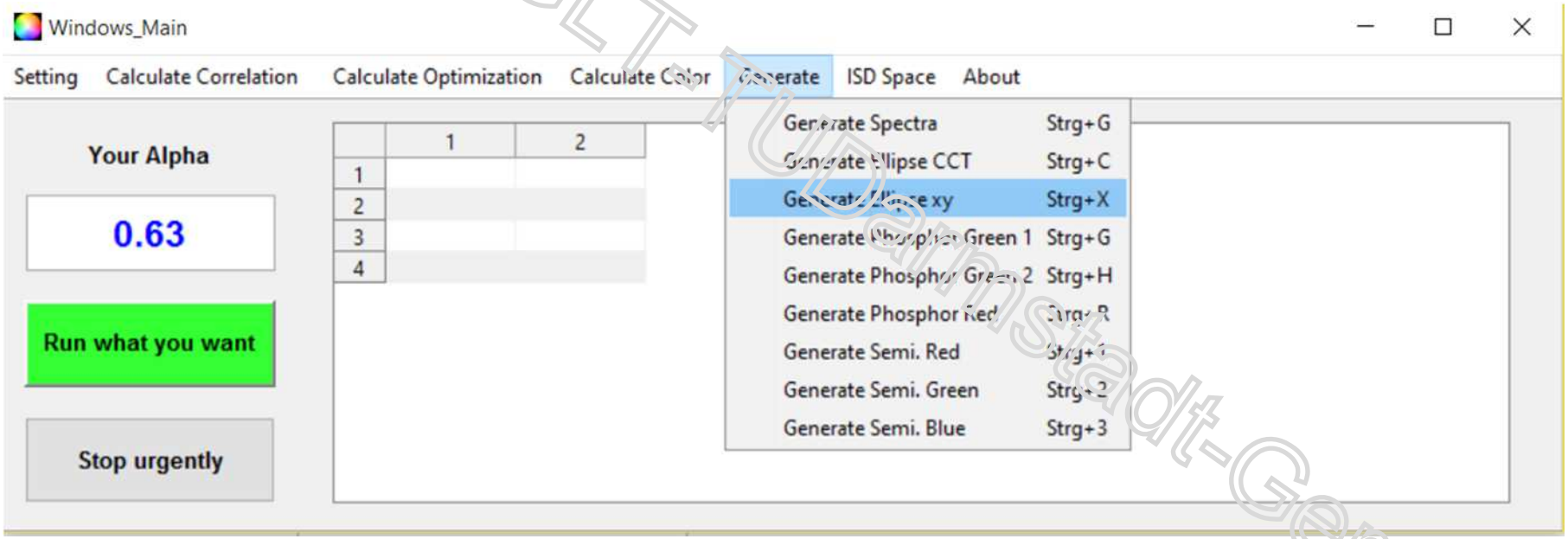
7- Sub-Mode 4 "*Generate*"



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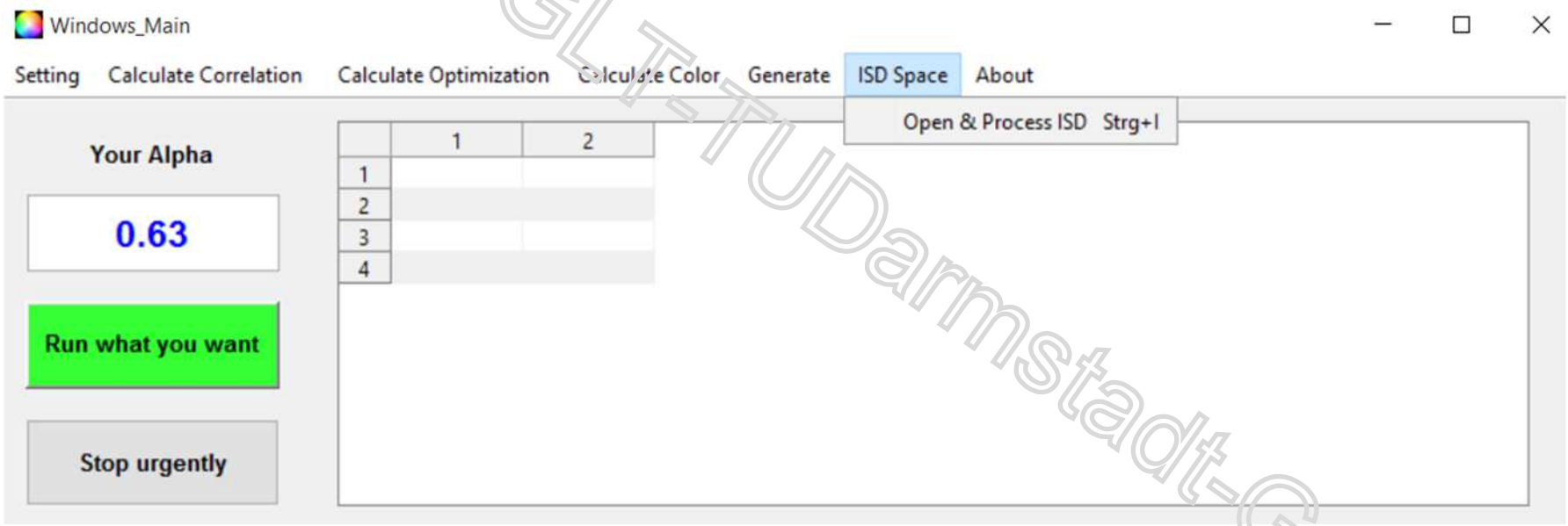
8- Sub-Mode 5 "*ISD Space*"



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Thanks for your attention!

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