ISBN 978-3-902842-49-7



International Commission on Illumination Commission Internationale de l'Eclairage Internationale Beleuchtungskommission

# PROCEEDINGS of CIE 2014 "Lighting Quality and Energy Efficiency"

23 – 26 April 2014

Hotel Istana

# Kuala Lumpur, Malaysia

CIE x039:2014

UDC: 628.9





## International Scientific Committee

Ohno, Yoshi (Chair)	US	CIE Vice-President Technical
Blattner, Peter	СН	CIE Director Division 2
Faidz, A.R.	MY	MyCIE
Gerloff, Thorsten	DE	CIE Division 2
Gibbons, Ron	US	CIE Associate Director Division 4
Goodman, Teresa	GB	CIE Vice-President Publications
Horak, Werner	DE	CIE Division 6
Lin, Yandan	CN	CIE Associate Director Division 4
Luo, Ronnier	GB	CIE Director Division 1
Morovic, Jan	GB	CIE Director Division 8
Nakamura, Yoshiki	JP	CIE Division 3, CIE Vice-President
O'Hagan, John	GB	CIE Director Division 6
Rengasamy, Narendren	MY	MyCIE
Schwarcz, Peter	ΗU	CIE Director Division 5
Tan, Ching Seong	MY	MyCIE
Zwick, Peter	AT	CIE Central Bureau Technical Manager

### **International Organizing Committee**

Webb, Ann (Chair)	GB	CIE President
Siew, C.T. (Chair)	MY	MyCIE
Goodman, Teresa	GB	CIE Vice-President Publications
Ohno, Yoshi	US	CIE Vice-President Technical
Paul, Martina	AT	CIE General Secretary
Whitehead, Lorne	CA	CIE Treasurer

Any mention of organizations or products does not imply endorsement by the CIE. Whilst every care has been taken in the compilation of any lists, up to the time of going to press, these may not be comprehensive.

Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from CIE Central Bureau at the address below.

© CIE 2014 - All rights reserved





The following table provides an overview of the oral presentations and posters presented at the conference. The papers are published in the proccedings in consecutive order of presentation. Papers that have not been submitted are marked as such ("n.s.").

The authors are responsible for the contents of their papers.

		Invited Presentations	Page
IT01	Y.Bhg Datuk Ir. Ahmad Fauzi bin Hasan	PROMOTING EFFICIENT USE OF ELECTRICAL ENERGY - MALAYSIA'S EXPERIENCE	n.s.
IT02	George Brainard	THE CAPACITY OF LIGHT TO REGULATE PHYSIOLOGY AND BEHAVIOR	n.s.
IT03	Tran Quoc Khanh	LIGHTING QUALITY FOR AUTOMOTIVE LIGHTING	1
IT04	George Brainard	EXPLORING THE POWER OF LIGHT: FROM PHOTONS TO HUMAN HEALTH	7
IT05	Thorsten Vehoff	CHALLENGES IN OLED DEVELOPMENT: HOMOGENEITY AND LIFETIME SCALING BEHAVIOR	20
IT06	Martine Knoop	LIGHTING QUALITY WITH LEDS	31
IT08	Janos Schanda	WHAT IS COLOUR FIDELITY IN MUSEUM LIGHTING?	36
IT09	David Sliney	ALMOST ALL LAMPS ARE SAFE, BUT SAFETY OF NEW LAMPS IS QUESTIONED	46

#### Please note: For direct access of a paper click on the respective page number.

		Oral Presentations	Page
Lighti	ng Quality with LED	Sources Chair: Martine Knoop	
OP01	Yamauchi, Y. et al.	DO OLEDS AND LEDS ILLUMINATIONS GIVE THE SAME IMPRESSIONS ON SPACE? - INTERNATIONAL SURVEY -	56
OP02	Li, H. et al.	SCALING APPEARANCE IN A ROOM ILLUMINATED BY LED SOURCES	63
OP03	Zhai, Q.Y. et al.	THE IMPACT OF THE LUMINANCE LEVELS AND COLOUR TEMPERATURE ON VIEWING FINE ART UNDER LED LIGHTING	73
OP04	Zhang, J. et al.	THE RELATION BETWEEN COMFORTABLE LIGHTING AND PERCEIVED GLARE	82
OP05	Kirsch, R., Voelker, S.	SOLID STATE LIGHTING IN OFFICES: IMPACT ON LIGHTING QUALITY AND ROOM APPEARANCE	88
Daylig	Daylighting Chair: Peter Dehoff		
OP06	Tralau, B., Schierz, C.	THE PREFERENCE OF COLOUR TEMPERATURE DEPENDING ON DAYLIGHT AND WEATHER	96

OP07	Wolff, C. et al.	ATRAPALUZ: DAYLIGHT SYSTEM TO INTERVENE SPACES AND PERCEPTION	103
OP08	Favero, F. et al.	NATURAL EXPERIMENT ON THE EFFECT OF ARTIFICIAL LIGHTING AND DAYLIGHT	113
OP09	lwata, T. et al.	EVALUATION ON VISUAL ENVIRONMENT IN A FAST FOOD RESTAURANT EQUIPPED WITH DAYLIGHT DUCT SYSTEM	120
OP10	Knoop, M.	ANALYSIS OF SPATIALLY RESOLVED MEASUREMENT APPROACHES TO ASSESS SPECTRAL CHARACTERISTICS OF SKY PATCHES	130
OP11	Hertog, W.	DAYLIGHT ASSISTED INDOOR LIGHTING	n.s.
Colou	r Quality (1)	Chair: Hiro Yaguchi	
OP12	David, A. et al.	WHITENESS METRIC FOR LIGHT SOURCES	140
OP13	Wei, M. et al.	BLUE-PUMPED LEDS FAIL TO RENDER WHITENESS	150
OP14	Luo, M. et al.	SPECIFICATIONS FOR THE CHROMATICITY OF WHITE LIGHT SOURCES	160
Roadw	vay and Street Lighti	ng (1) Chair: Yandan Lin	
OP15	Gibbons, R., Lutkevich, P.	THE IMPACT OF LIGHTING LEVEL ON VEHICLE SAFETY	n.s.
OP16	Fotios, S. et al.	LIGHTING FOR PEDESTRIANS: WHAT ARE THE CRITICAL VISUAL TASKS?	164
OP17	Hagio, T. et al.	RELATIONSHIP BETWEEN UNIFORMITY AND DISCOMFORT FOR TUNNEL INTERIOR LIGHTING	174
Lighti	ng and Health (1)	Chair: David Sliney	
OP18	Price, L.L.A., Peirson, S.N.	THE FIRST INTERNATIONAL WORKSHOP ON CIRCADIAN AND NEUROPHYSIOLOGICAL PHOTORECEPTION, 2013: A PHYSICIST'S PERSPECTIVE ON THE CONSTRUCTION OF STANDARD UNITS	182
OP19	Mou, T. et al.	EVALUATION OF SPECTRORADIOMETER PERFORMANCE FOR APPLICATION OF PHOTOBIOLOGICAL SAFETY ASSESSMENT OF LIGHTING PRODUCTS	186
OP20	Sullivan, J., Donn, M.	A REVIEW OF MEASURES THAT MAY BE USED TO EXAMINE THE EFFECTS OF DAYLIGHT ON PEOPLE	n.s.
Colou	r Quality (2)	Chair: Janos Schanda	
OP21	Ohno, Y., Fein, M.	VISION EXPERIMENT ON ACCEPTABLE AND PREFERRED WHITE LIGHT CHROMATICITY FOR LIGHTING	192
OP22	Liu, X.Y. et al.	INVESTIGATING OBSERVER VARIABILITY FOR ASSESSING MEMORY COLOURS	200
OP23	Mizokami, Y. et al.	EVALUATION OF LED LIGHTING QUALITY BASED ON COLOUR DISCRIMINATON ASSESSED BY 100-HUE TESTS	206
OP24	David, A.	COLOUR FIDELITY EVALUATED OVER LARGE REFLECTANCE DATASETS	213

Roadw	ay and Street Lightin	ng (2) Chair: Ron Gibbons	
OP25	Lai, D. et al.	INFLUENCE OF LIGHT SOURCE LUMINANCE ON DISCOMFORT GLARE FROM LED ROAD LUMINAIRES	220
OP26	Saraiji, R.	DOMINANT CONTRAST AND VERTICAL ILLUMINANCE FOR PEDESTRIAN ILLUMINATION	228
OP27	Porsch, T. et al.	MEASUREMENT OF THE THRESHOLD INCREMENT (TI) IN ROAD LIGHTING BASED ON USING ILMD	237
OP28	Webb, A. et al.	TRANSPORT SIGNALLING IN FOG:TECHNIQUES FOR EXPLORING LED REPLACEMENTS FOR MISSION CRITICAL TASKS.	n.s.
Lightir	ng and Health (2)	Chair: David Sliney	
OP29	Pan, J. et al.	KEY ASPECTS FOR PHOTOBIOLOGICAL SAFETY MEASUREMENT	244
OP30	Wang, Y.T. et al.	MEASURING DISCOMFORT GLARE OF MOTION PICTURES ON RGB LED BILLBOARD AT NIGHT	n.s.
OP31	Hao, L. et al.	EXPERIMENTS ON HEALTHY LIGHTING AND THE TENTATIVE APPLICATION OF LEDS AT CHINESE ANTARCTIC STATIONS	253
OP32	Säter, M.	ECO LIGHTING DESIGN PROCESS	259
Coloui	Colour Quality and Mesopic Vision Chair: Ronnier Luo		
OP33	Bodrogi, P. et al.	COLOUR APPEARANCE OF MESOPIC RELATED COLOURS AT 0.3, 1, 3 AND 10 CD/M2: VISUAL MAGNITUDE ESTIMATION AND MODELLING	266
OP34	Uchida, T., Ohno, Y.	ANGULAR CHARACTERISTICS OF THE SURROUNDING LUMINANCE EFFECT ON PERIPHERAL ADAPTATION STATE IN THE MESOPIC RANGE	273
OP35	Lin, Y. et al.	A PILOT STUDY OF THE PHYSIOLOGICAL MECHANISM OF THE GLARE CAUSED BY LED BASED ON THE FLUCTUATION OF THE ELECTRO- OCULOGRAM	281
OP36	Tsai, Y.C. et al.	TOWARDS A SYSTEM FOR DIGITAL QUANTIFICATION OF COLOUR DISCRIMINATION AND COLOUR DEFICIENCY	287
OLED	for Lighting	Chair: Tony Bergen	
OP37	Yamauchi, Y. et al.	EFFECTS OF THE POSTURE OF OLED PANELS ON THE FLUX MAINTENANCE	294
OP38	Gerloff, T. et al.	COLOUR RENDERING PROPERTIES OF OLED SPECTRA	n.s.
OP39	Park, S. et al.	SELF-SCREENING CORRECTION FOR LARGE-AREA LIGHT SOURCES USING AN AUXILIARY LAMP MATCHED TO THEIR SPATIAL DISTRIBUTION IN AN INTEGRATING SPHERE PHOTOMETER	n.s.
Lightin	ng Design	Chair: Yoshiki Nakamura	
OP40	Zaikina, V. et al.	NEW MEASURES OF LIGHT MODELLING	298

OP41	Scheir, G. et al.	APPLICABILITY OF THE UNIFIED GLARE RATING AS ASSESSMENT OF DISCOMFORT GLARE SENSATION BASED ON LUMINANCE MAPS	306
OP42	Chung, T.M. et al.	EVALUATING DISCOMFORT GLARE FROM WINDOWS WITH NON-UNIFORM LIGHT DISTRIBUTION	314
OP43	Leibmann, H. et al.	BALANCING LIGHTING QUALITY, ENERGY EFFICIENCY AND COST IN COMBINATION WITH REAL TIME SIMULATION TECHNOLOGY	324
OP44	Szabo, F. et al.	ACCEPTANCE STUDIES ON INTELLIGENT ADAPTIVE CORRIDOR LIGHTING	337
OP45	Dehoff, P.	MEASURES FOR A BETTER QUALITY IN LIGHTING A JOURNEY THROUGH RECENT ACTIVITIES IN APPLICATIONS AND STANDARDS	348
Outdo	or Lighting	Chair: Peter Schwarcz	
OP46	Fotios, S. et al.	INTERPERSONAL JUDGEMENTS, LAMP SPECTRUM AND TASK DIFFICULTY	357
OP47	Yang, X. et al.	URBAN ARCHITECTURAL LIGHTING IN CHINA: AN INSPIRING QUALITATIVE STUDY TO DEMONSTRATE ITS DISTINCTIVENESS AND ALSO SIMILARITIES TO INTERNATIONAL PRACTICES	367
OP48	Djokic, L. et al.	THE IMPORTANCE OF DEVELOPING A CITY STREET LIGHTING MAP	376
OP49	Wu, P.J. et al.	A GLARE DETECTION SYSTEM WITH A DIGITAL CAMERA FOR HUMAN CARE	380
OP50	Pong, B.J. et al.	SIMULTANEOUS MEASUREMENTS OF GLARE AND FLICKER PROPERTIES OF ENVIRONMENTAL LIGHTINGS	384
OP51	Nath, D. et al.	A NOVEL APPROACH ON OUTDOOR SPORTS LIGHTING DESIGN METHODOLOGY AND ITS VALIDATION BY SENSITIVITY ANALYSIS	392
SSL M	easurement and Tes	ting Chair: Peter Blattner	
OP52	Poikonen, T. et al.	ADJUSTABLE POWER LINE IMPEDANCE EMULATOR FOR CHARACTERISATION OF ENERGY-SAVING LIGHTING PRODUCTS	403
OP53	Corell, D. et al.	LUMINOUS FLUX AND COLOUR MAINTENANCE INVESTIGATION OF INTEGRATED LED LAMPS	408
OP54	Yang, T.H. et al.	MEASURING CHARACTERISTICS OF LEDS BY MONITORING TURN-ON TRANSIENT BEHAVIOURS	415
OP55	Yuqin Zong, Shen, H.	DEVELOPMENT OF 2π TOTAL SPECTRAL RADIANT FLUX STANDARDS AT NIST	421
OP56	Austin, R. et al.	LOW UNCERTAINTY ABSOLUTE CHARACTERIZATION OF TOTAL PHOSPHOR SPECTRAL EMISSION AS A FUNCTION OF EXCITATION WAVELENGTH	n.s.
Right	Lighting in Outdoor	Chair: Dionyz Gasparovsky	
OP57	Chung, T.M. et al.	GLARE EVALUATION OF OUTDOOR TENNIS COURT FLOODLIGHTING USING HIGH DYNAMIC RANGE PHOTOGRAPHY	427

L

OP58	Parry, N.	PIONEERING LED STREET LIGHTING ENERGY SAVING PROJECT	n.s.
OP59	Sampaio, J.N.	A SENSE OF WASTE: LIGHT URBAN DESIGN TACTICS	437
OP60	Chong, W.T. et al.	ECO-GREENERGY WIND-SOLAR HYBRID RENEWABLE ENERGY LIGHTING AND CHARGING SYSTEM	444
OP61	Gasparovsky, D. et al.	BENCHMARKING THE ENERGY EFFICIENCY OF ROAD LIGHTING	451
Advan	cement in Photomet	ry and Radiometry Chair: Armin Sperling	
OP62	Young, R., Neumeier, J.	HIGH ACCURACY IMAGING COLORIMETRY	461
OP63	Li, S. et al.	A NOVEL CONTINUOUS SCANNING METHOD FOR GONIOSPECTRORADIOMETRY	470
OP64	Rossi, G. et al.	GONIOPHOTOMETRIC CHARACTERIZATION OF OPAQUE CONSTRUCTION MATERIALS (COOL MATERIALS)	476
OP65	Ikonen, E. et al.	CALIBRATION OF SPECTRAL RESPONSIVITY OF IMAGING DEVICES USING LED LIGHT SOURCES	n.s.
OP66	Hall, S.R.G. et al.	UNCERTAINTY BUDGET ASSESSMENT FOR PRACTICAL ASSESSMENT OF THE RETINAL HAZARD OF EXTENDED LIGHT SOURCES IN ACCORDANCE WITH IEC 60825 AND IEC 62471 GUIDELINES	485

		Posters	Page
PP01	Rizzi, A. et al.	A TEST OF COLOUR RENDERING EVALUATION	498
PP03	Lee, E.J., Fuchida, T.	A STUDY ON THE COLOR APPEARANCE OF CLOTHING UNDER VARIABLE COLOR TEMPERATURE AND ILLUMINANCE OF VARIOUS LIGHT SOURCES INCLUDING LED LAMPS	504
PP04	Nakajima, Y., Fuchida, T.	A STUDY ON THE EVALUATION METHOD OF COLOR RENDERING PROPERTIES OF MUSEUM LIGHTING AT LOW ILLUMINANCE	513
PP05	Huang, S.G. et al.	COMPUTATION AND EVALUATION ON DUV PROPERTY OF LED LUMINAIRES	522
PP06	Linke, S. et al.	SIMULATING OF LED SUM-SPECTRA FOR THE BEST COLOR RENDERING INDEX ALONG THE BLACK BODY CURVE – A REVERSE ENGINEERING ATTEMPT	n.s.
PP07	Cengiz, C. et al.	REACTION TIME MEASUREMENTS TO PERIPHERAL STIMULI ON UNIFORM AND NON-UNIFORM BACKGROUNDS UNDER MESOPIC LIGHT LEVELS	532
PP08	Iwata, M. et al.	VISIBILITY EVALUATION FOR FACE OF PERSON STANDING UNDER LED STREET LIGHTING ENVIRONMENT	538
PP09	Fu, H.K. et al.	THE STUDY OF BANDPASS CORRECTION IN ARRAY SPECTROMETER MEASUREMENT	546

PP14	Velázquez, J.L. et al.	ZERNIKE POLYNOMIALS FOR PHOTOMETRIC CHARACTERIZATION OF LEDS	551
PP16	Thorseth, A. et al.	COMPARISON OF STRAY LIGHT IN SPECTROMETER SYSTEMS USING A LOW COST MONOCRHOMATIC LIGHT SOURCE	557
PP17	Dubnicka, R. et al.	DEFINING LUMINOUS INTENSITY DISTRIBUTIONS OF LED LUMINAIRES BY THE MEASUREMENT OF ROTATING LUMINAIRE GONIOPHOTOMETERS	565
PP18	Wang, J. et al.	MEASUREMENT AND EVALUATION OF FLICKER OF LED LIGHTING SOURCES BASED ON THE EYE'S TEMPORAL PERCEPTION	573
PP19	Godo, K. et al.	EVALUATION OF RELATIONSHIPS BETWEEN TEMPERATURE AND ELECTICAL PROPERTIES FOR SSL PHOTOMETRIC MEASUREMENTS	579
PP20	Goodman, T. et al.	THE USE OF F1' AS A QUALITY INDEX FOR NON- PLANKIAN SOURCES	n.s.
PP21	Hall, S.R.G. et al.	BEAM PROPAGATION RATIO PARAMETERS, TRACEABLE TO NATIONAL MEASUREMENT STANDARDS	583
PP23	Novak, T. et al.	SUPERCAPACITOR AS A SOURCE FOR AUTONOMOUS EMERGENCY LUMINAIRE	588
PP25	Ho, J. et al.	DAYLIGHT DESIGN PERFORMANCE BY USING HONG KONG REPRESENTATIVE SKIES	596
PP28	Ito, D.	OUTDOOR MEASUREMENT ON LUMINOUS EFFICACY OF WINDOW	601
PP29	Bian, Y. et al.	THE COMPOSE OF REFERENCE SKY MODEL SUPERIMPOSED ON THREE TYPICAL SKY COMPONENT	605
PP30	Chan, T.K.C.,Tsang, E.K.W.	LIGHTING DESIGN FOR MITIGATING VEILING REFLECTION IN INDOOR SWIMMING POOL	611
PP31	Chan, T.K.C.,Tsang, E.K.W.	DAYLIGHT DESIGNS FOR HOSPITAL UNDER SUBTROPICAL CLIMATE	621
PP32	Szabo, F. et al.	MUSEUM LIGHTING WITH LEDS: LED LIGHTING FOR THE SISTINE CHAPEL	629
PP34	Yuan, Y. et al.	VISUAL IMPRESSIONS OF COLOURED LED LIGHTINGS IN AN INDOOR SPACE	638
PP35	Gasparovsky, D. et al.	LIGHTING QUALITY AND ENERGY EFFICIENT ILLUMINATION OF SCHOOL BOARDS	643
PP37	Simonian, D., Paolini, S.	ILLUMINATION SYNTHESIS AND PLAYBACK BY A LIGHT PLAYER	653
PP38	Säter, M.	GOALS FOR ENERGY EFFICIENT LIGHTING PUT INTO HIERARCHY	661
PP39	Säter, M.	LIGHTING DESIGN PROCESS FOR ENERGY EFFICIENT LIGHTING	670
PP40	Cheng, C.C. et al.	ASSESSMENT ON LIGHTING QUALITY AND ENERGY CONSERVATION FOR LIGHTING ENVIRONMENTAL EXPERIENCE DESIGN OF A CONVENIENCE STORE	681

PP41	Dubnicka, R. et al.	PROPOSAL OF GUIDLINE OF PRACTICAL VERIFICATION OF INDOOR LIGHTING SYSTEMS ACCORDING TO ISO 8995-1:2002(E)/CIE S008/E:2001	693
PP42	Dubnicka, R. et al.	INFLUENCE OF ACCURACY LUMINOUS INTENSITY DISTRIBUTION MEASUREMENT ON LIGHTING DESIGN REALISATIONS	703
PP43	Dubnicka, R. et al.	SPECTRORADIOMETRIC ANALYSIS OF SKY TYPES ACCORDING TO CIE DOCUMENT CIE S 011/E:2003	708
PP44	Okuda, S. et al.	PREFERABLE LIGHTING CONDITIONS FOR MIGRAINEURS TO RELAX IN ROOM	716
PP45	Suzuki, N. et al.	PROPOSAL OF LIGHTING METHOD IN CLASSROOM OF PRIMARY SCHOOL CONSIDERING THE TEACHERS' BRIGHTNESS SENSATION	720
PP46	Hirning, M.B. et al.	A MODIFIED DISCOMFORT GLARE INDEX FOR GREEN BUILDINGS	726
PP47	Wu, Y. et al.	EVALUATION METHOD RESEARCH ON DISCOMFORT GLARE OF LED PRODUCTS	736
PP48	Chou, C.J. et al.	MUSEUM LIGHTING ENVIRONMENT: BUILD UP PERCEPTION ZONE MAPS ON LED ILLUMINATION	743
PP49	Chao, W.C. et al.	INFLUENCES OF FLICKER CHARACTERISTICS FROM LIGHTING SYSTEMS ON HUMAN PERCEPTION	753
PP51	Peng, S. et al.	ENVIRONMENTAL INFLUENCE ON BACKGROUND LUMINANCE PREFERENCE OF COMPUTER USE AT HOME	762
PP52	Takahashi, H. et al.	THE INFLUENCE OF ELAPSED TIME AND ILLUMINANCE/COLOR TEMPERATURE ON THE SUBJECTIVE EVALUATION OF INTERIOR LIGHTING	767
PP53	Hara, N., Kato, M.	WHICH SETTINGS OF LIGHTING SYSTEM ARE EFFECTIVE FOR LOW ENERGY CONSUMPTION?	n.s.
PP54	Govén, T. et al.	ENERGY EFFICIENT AND STUDY PROMOTING LIGHTING AT HIGH SCHOOL: PRELIMINARY RESULTS.	772
PP55	Li, D.	A STUDY OF THE SWITCHING FREQUENCY FOR VARIOUS PHOTOELECTRIC ON-OFF APPROACHES BASED ON MEASURED DAYLIGHT DATA	780
PP56	Kobav, M., Bizjak, G.	USE OF A COMPACT CCD CAMERA FOR CONTINUOUS MEASUREMENT OF SKY LUMINANCE DISTRIBUTION AND THE CLASSIFICATION OF THE CIE SKY TYPE	787
PP58	Yao, Y., Zhang, M.	INVESTIGATION AND STUDY ON DAYLIGHTING SITUATION OF THE SCHOOL GYMNASIUM	792
PP60	Zhao, J., Wang, S.	RESEARCH ON ENERGY STANDARD FOR BUILDING LIGHTING	802
PP61	Fumagalli, S. et al.	HUMBLEBEE - INNOVATIVE LIGHING SYSTEM AT ENEA - ISPRA	808
PP62	Ruszaini, N.D. et al.	POWER QUALITY ASSESSMENT ON VARIOUS TYPE OF STREET LIGHT IN TNB DISTRIBUTION SYSTEM	815
PP63	Lorphèvre, R. et al.	ECONOMICAL IMPACT OF G CLASSES ON LED PHOTOMETRY	820

PP64	Lorphèvre, R. et al.	LED TUNNEL LUMINAIRES: WITH OR WITHOUT A PROTECTOR?	827
PP65	Fotios, S. et al.	EMPIRICAL EVIDENCE TOWARDS APPROPRIATE LIGHTING CHARACTERISTICS FOR PEDESTRIANS	833
PP66	Fotios, S.	ROAD LIGHTING AND PEDESTRIAN REASSURANCE AFTER DARK: A REVIEW OF THE EVIDENCE	843
PP67	Guo, P. et al.	RESEARCH ON SIMULATION ANALYSIS OF SAFETY EVALUATION INDEX OF CLOVERLEAF WITH HIGH MAST LIGHTING	853
PP68	Romnée, A., Bodart, M.	STREET LIGHTING APPRECIATED BY PEDESTRIANS: A FIELD STUDY	862
PP69	Romnée, A., Bodart, M.	DOES LED LIGHTING IMPROVE PEDESTRIANS VISUAL PERFORMANCES?	873
PP70	Chakraborty, S. et al.	AN EXPERIMENTAL APPROACH FOR DETERMINING THE EFFECT OF ROAD SURFACE DEPRECIATION ON ROAD LIGHTING DESIGN	884
PP71	Wang, S., Zhao, J.	THE INFLUENCE OF LED LUMINOUS FLUX MAINTENANCE FACTOR ON THE DETERMINATION OF MAINTENANCE FACTOR	894
PP72	Ueda, K. et al.	IMPLEMENTATION OF HIGH S/P RATIO SOURCE TO EXPRESSWAY LIGHTING MAY ENHANCE PURKINJE PHENOMENON	899
PP73	Dubnicka, R. et al.	MEASUREMENT OF LUMINANCE DISTRIBUTION OF STREET LIGHT UNDER DIFFERENT WEATHER CONDITIONS	907
PP74	Rossi, G. et al.	MEASUREMENT PROCEDURE FOR MESOPIC IN FIELD CHARACTERIZATION OF SSL ROAD LIGHTING INSTALLATIONS	916
PP77	Kohko, S. et al.	GLARE OF LED LIGHTING IN OUTDOOR ENVIRONMENT	924
PP78	Han, J. et al.	A NEW LUMINAIRE CLASSIFICATION METHOD FOR KOREAN CITY AREA LIGHTING	930
PP80	Lim, J.M. et al.	MEASURE THE BRIGHTNESS OF THE SURROUNDING TREE-LINED OUTDOOR LIGHTING COMPARED	935
PP81	Song, G.	SPILL LIGHT INVESTIGATION AND ANALYSIS OF HIGH POWER LED UPLIGHT BASE ON DIFFERENT URBAN APPLICATION AREAS	n.s.
PP83	Price, L.L.A.	BEYOND THE LABORATORY - THE DYNAMICS OF LIGHT EXPOSURE DOSIMETRY IN THE MELANOPSIN AGE	940
PP84	Price, L.L.A. et al.	MEASUREMENTS OF IN-FLIGHT UV EXPOSURES OF PILOTS	946
PP85	Price, L.L.A. et al.	TEMPERATURE DEPENDENCE OF ARRAY SPECTRORADIOMETERS AND IMPLICATIONS FOR PHOTOBIOLOGISTS	950
PP86	Mochizuki, E. et al.	WINDOW EFFECTS ON RELAXATION AND CIRCADIAN REGULATION	957
PP87	Prado, E. et al.	POTENTIAL HAZARD OF LED SOURCES TO CAUSE BLH IN SPECIFIC POPULATION	967