Report on 20th International Conference on Flow Injection Analysis and Related Techniques (ICFIA 2016) held in Mallorca, Spain, October 2–7, 2016

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1. Introduction

The joint meeting of ICFIA and the Japanese Association for Flow Injection Analysis (JAFIA) was held in the beautiful Mediterranean city of Palma de Mallorca. Palma de Mallorca is a city located in the Mallorca Island off the coast of Spain. The conference took place at the Hotel Barceló Pueblo Park, located in the Playa de Palma area.

It was hosted by Victor Cerdà, University of the Balearic Islands, and colleagues from the local organizing committee: Fernando Maya (Secretary), Carlos Calderilla, José Calvo, Sabrina Clavijo, José M. Estela, Laura Ferrer, Rejane Frizzarin, Esteve Gomila, Alba González, Joan March, Edwin Palacio, Lindomar Portugal, Melisa Rodas, Antonio Serra, Ruth Suárez, and Marina Villar.

It was organized by the Association of Environmental Sciences and Techniques (AEST) founded and directed by Prof. Dr. Víctor Cerdà, the Japanese Association for Flow Injection Analysis (JAFIA), the University of the Balearic Islands (UIB), and the Spanish Society of Analytical Chemistry (SEQA), and was hosted by Sciware Systems, S.L., also an exhibitor.

There were 143 participants from 19 countries: Australia, Brazil, Canada, China, Czech Republic, Egypt, France, Germany, Greece, Japan, Mexico, Poland, Portugal, Russian Federation, Spain, Sweden, Thailand, the United States, and Uruguay. Thailand was well represented with 32 participants. And JAFIA had a usual large contingent with 13 participants. There were a total of 62 student participants.

The conference was opened by a greeting from Rector Llorenç Huguet of the University of the Balearic Islands, and comments from Víctor Cerdà, Toshihiko Imato and Gary Christian.

2. Social Events

A welcome cocktail reception was held Sunday evening at the patio of the Hotel Barceló Pueblo Park. Refreshments and snacks were served. Wednesday was free when we were treated to a Valldemossa-Deia-Sóller guided bus tour, with lunch included.

The conference banquet was held Thursday evening at the Restaurante Bahia Mediterraneo in the Paseo Maritimo (Palma de Mallorca Seaside Promenade).

3. Scientific Program

The program included opening and closing lectures, 3 keynote lectures, 9 invited lectures, 38 oral presentations, 21 short oral communications, and 87 poster presentations, held Monday, Tuesday, Thursday, and Friday. The 14 oral presentation sessions were chaired by Spas Kolev, Gary Christian, Andrey Bulatov, Raquel Mesquita, Frantisek Svec, Victor Cerdà, Kate Grudpan, Burkhard Horstkotte, José Costa Lima, Petr Solich, Aristidis Anthemidis, Joanna Kozak, Gulnara Safina, Luz Leal, Sabrina Clavijo, Bruno Coulomb, Toshihiko Imato, Paweł Kościelniak, Jean-Luc Boudenne,

Fernando Maya, Shoji Motomizu, Norio Teshima, Laura Ferrer, Jorge Guzman, Duangjai Nacapricha, Kanchana Uraisin, António Rangel, and Ines Almeida.

4. Keynote/Invited Lectures

The program began Monday morning with an **opening lecture** by *Gary Christian* (University of Washington, USA) entitled "Can Concentrated Salts Help FIA?". He illustrated that concentrated salts can enhance acid-base titration curves in both aqueous and nonaqueous solvents, allowing titration of bases with Kb values as small as 4×10^{-14} in acetone in the presence of 3*M* $LiClO_4$. These effects may find use in FIA systems and other analytical applications. In the **closing lecture**, *António Rangel* (Universidade Católica Portuguesa, Portugal) presented a view on the strengths and limitations of flow-based approaches for food and environmental monitoring, with the need for analyte enrichment; minimization of interferences; need for efficient sampling procedures; coping with a wide range of analyte concentrations; achieving speciation of different forms of the analyte; searching for greener chemistries; and reducing sample consumption without compromising representativeness of the target material.

Keynote Lectures

In the first keynote lecture, *Petr Solich* (Charles University, Faculty of Pharmacy, Czech Republic) described the use of flow techniques in the pharmaceutical area, either for simple automation and sample preparation, for monitoring of pharmaceutically important procedures, or as a simple alternative for separation procedures. *Toshihiko Imato* (Kyushu University, Japan) described electrogenerated chemiluminescence-based analysis on a compact disc-type microchip. *Duangjai Nacapricha* (Mahidol University, Thailand) traced the evolution of membraneless gas-liquid separation, from tubular-based flow systems to microfluidic paper-based analytical devices.

Invited Lectures

Shoji Motomizu (Okayama University, Japan) gave an invited lecture on mobile chemical analysis (MCA) computer controlled flow analysis using multi-channel detectors as useful systems for MCA. *Spas Kolev* (The University of Melbourne, Australia) described the online fractionation and speciation of bioaccessible inorganic and organic mercury in environmental solid samples with a hybrid sequential extraction-cold vapor generation-atomic fluorescence spectrometric system. *Frantisek Svec* (Beijing University of Chemical Technology, China and Lawrence Berkeley National Laboratory, USA) used porous polymer monolithic columns for sequential injection chromatography, tailoring their size porous properties, and chemistry.

Lúcia Saraiva (University of Porto, Portugal) described the use of ionic liquids in biocatalysis, their potentials and pitfalls. *Burkhard Horstkotte* (Charles University, Faculty of Pharmacy) reported on a lab-in-syringe as a tool for automatic head-space single drop microextraction and on-drop sensing. *Elias Zagatto* (Center for Nuclear Energy in Agriculture, Sao Paulo University, Piracicaba, Brazil) considered factors in flow analysis that affect the application of the Beer-Lambert law, including the Schlieren effect, and recent proposals to improve

linearity of the analytical curve.

Paweł Kościelniak (Jagiellonian University in Krakow, Poland) described recent achievements in the calibration domain of flow analysis in order to obtain improved precision and accuracy. *Kate Grudpan* (Chiang Mai University, Thailand) reviewed historical contributions of Chiang Mai researchers, from conventional cost effective flow injection analysis to modern chemical analysis. *Kanchana Uraisin* (Mahidol University) described an on-line monitoring system with a gas flow reactor for the study of the efficiency of synthesized TiO_2 catalyst for NO_2 removal.

5. Oral Presentations

Instrumentation/detection/devices/software

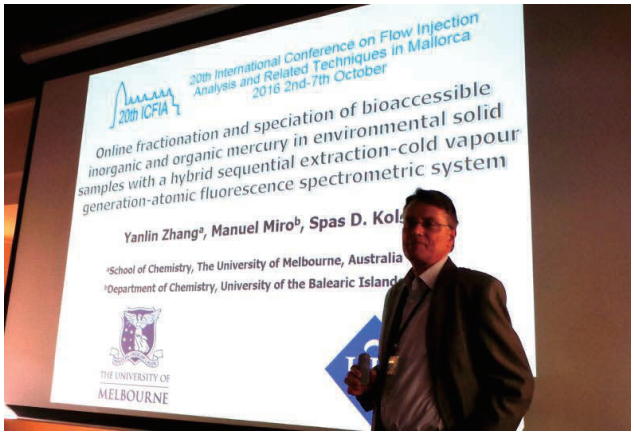
There were a number of presentations dealing with novel systems for performing flow analysis measurements. *Graham Marshall* (Global FIA, USA) presented what belongs in a well-stocked flow-based analysis toolkit, reviewing instrumentation developments that have improved the efficiencies of flow-based analyses. *Gulnara Safina* (University of Gothenburg and Chalmers University of Technology, Sweden) used surface plasmon resonance as a novel analytical tool for studying cellular processes *in-situ*. *Masaki Takeuchi* (Tokushima University, Japan) described a nitric acid gas generator for air analysis. *Ines Almeida* (The University of Melbourne) determined nutrients in environmental waters using microfluidic paper-based devices.

Nathawut Choengchan (King Mongkut's Institute of Technology Ladkrabang, Thailand) described cross injection analysis and its application for single or multi-analyte determination. *Antonio Borràs* (University of the Balearic Islands, Spain) developed a flow cell detector for radionuclide determination to integrate in a miniature flow system. *Napaporn Youngvises* (Thammasat University, Thailand) reported on microfabrication of double-sided microfluidic systems for mulit-analyte determinations. *Kanokwan Kiwfo* (Chiang Mai University) described noodle based microfluidic devices.

Sutasinee Apichai (Chiang Mai University) developed a simple device based on a moving drop for down scaling chemical analysis in a drop size with a mobile phone application. *Phoonthawee Saetear* (Université de Montpellier – Ecole Nationale Supérieure de Chimie de Montpellier, France) described Taylor dispersion analysis of polysaccharides using backscattering interferometry detection.

Separation, preconcentration, reactors, reagents

Various approaches were utilized in sample handling and analysis. *Andrey Bulatov* (Saint Petersburg State University, Russia) developed an automated homogeneous liquid-liquid extraction based on a flow system. *Raquel Mesquita* (Universidade Católica Portuguesa) applied polymer inclusion membranes (PIMs) for in-line solid phase extraction in flow analysis, with a packed column approach for cobalt(II) determination. *Fernando Maya* (University of the Balearic Islands) used novel sorbents for solid-phase extraction using flow techniques. *Petr Chocholouš* (Charles University, Faculty of Pharmacy) described a SPE-SIC method for on-line sample pre-treatment and separation.



Andrey Shishov (Saint Petersburg State University) developed an on-line reversed-phase chromatomembrane extraction system coupled with ion-exchange chromatography. *Víctor Cerdà* discussed from thermometric to spectrophotometric kinetic-catalytic methods of analysis. *Christina Vakh* (Saint Petersburg State University) reported on analytical applications of flow chemiluminescence analysis coupled with separation and preconcentration methods. *Sabrina Clavijo* (University of the Balearic Islands) described analytical strategies for coupling separation and flow injection techniques.

Joanna Kozak (Jagiellonian University in Krakow) presented titration techniques in flow analysis. *Irina Timofeeva* (Saint Petersburg State University) reported on an automated

HPLC determination of ofloxacin in chicken meat with on-line microextraction. *Ryoichi Ishimatsu* (Kyushu University) developed a flow injection immunoassay for a degeneration product of herbicides, 3-phenylbenzoic acid, with fluorescent carbon nanodots. *Marcin Wieczorek* (Jagiellonian University in Krakow) developed a new approach for detection and elimination of unspecified interference effects in samples of unknown and complex matrix.

Kazuhiko Tsukagoshi (Doshisha University, Japan) described protein separation with tube radial distribution chromatography using a PTFE capillary tube based on phase separation multi-phase flow. *Norio Teshima* (Aichi Institute of Technology, Japan) developed auto-pretreatment systems based on sequential injection solid phase extraction. *Nuanlaor Ratanawimarnwong* (Srinakharinwirot University, Thailand) developed a membraneless vaporization unit with two cone shape reservoirs for zone fluidics.

Applications

Flow and related methods continue to offer advantage in providing analytical solutions, as evidenced from the variety of reported applications. *Susana Vidigal* (Universidade Católica Portuguesa) described a flow-based platform for measuring the acidity parameters in wine. *Georgia Giakisikli* (Aristotle University of Thessaloniki, Greece) developed an integrated miniSIA system for fluorimetric ammonium determination in recycling and potable water samples in micro gravity (space) environment. *Ana Machado* (University of Porto) developed a robust, fast screening method for the potentiometric determination of iodide in urine samples.

Pawel Świt (Jagiellonian University in Krakow) developed a generalized calibration strategy towards elimination of additive interference effects. *Tamer Hasanin* (Minia University, Egypt) reported on a flow-injection chemiluminescence analysis for the sensitive determination of ascorbic acid using luminol. *Jean-Luc Boudenne* (Aix Marseille Université, France) reported on a multi-syringe flow injection determination of Fe(III) and Al(III), adapting a lab system to industrial requirements. *Polina Davletbaeva* (Saint Petersburg State University) determined synthetic water-soluble colorants in cough-cold formulations by sequential injection chromatography. *Inês Ramos* (University of Porto) used micro-bead injection spectroscopy for assessment of total IgG levels.

Poachanee Norfun (Chiang Mai University) described the sequential injection assay of total antioxidant capacities in tea infusions by a graphene electrode. *Kazuaki Ito* (Kindai University, Japan) reported on the simultaneous determination of inorganic nitrogen species in seawater samples. *José Neri-Quiroz* (CEA Nuclear Energy Division, Radiochemistry & Processes Department, France) miniaturized free acidity measurements for uranium(VI)-HNO3 solutions, developing a sustainable radio-analytical chemistry through sequential injection analysis.

Justyna Paluch (Jagiellonian University in Krakow) described a novel approach to two-dimensional determination in speciation analysis with spectrophotometric determination, using simultaneous application of two calibration methods for the determination of different forms of an analyte. *Edgar Paski* (Analytical Innovations, Canada) described making FIA/SIA based measurements metrologically traceable and fit for purpose.

6. Short Oral Presentations

Special sessions with 10 minute talks, featuring young scientists, were held Monday, Tuesday, and Thursday afternoons.

Instrumentation/detection/devices/software

Jani Tuoriniermi (University of Gothenburg, Sweden) developed a surface plasmon resonance based method for the study of colloids. *Keisuke Nakaubo* (Kyushu University) fabricated a micro/nano optical system and integrated it in Ga-PDMS for silicone optical technology. *Natcha Kaewwonglom* (Chiang Mai University) developed a programmable hydrodynamic flow injection amperometric system for remote monitoring of dissolved oxygen in water. *Jantima Upan* (Chiang Mai University) described a flow injection amperometric sensor for determination of methyldopa using gold nanoparticles decorated on a carbon nanotube modified screen printed electrode.

Florencio de la Torre (Universitat de Girona, Spain) reported on the implementation of a mixing flow cell to a SIA system for polyphenol determination. *Moisés Knochen* (Universidad de la República, Uruguay) used a multi-pumping flow system for the determination of nitrate and nitrite in water samples based on open-source hardware/software. *Prakit Chuntib* (Chiang Mai University) developed a sequential injection differential pulse voltammetric method based on a screen printed carbon electrode modified with carbon nanotube/Nafion for paraquat determination.

Separation, preconcentration, reactors, reagents

Niramol Jitsommai (Mahidol University) developed a direct colorimetric measurement of urinary thiocyanate using flow analysis with on-line sample pretreatment. *Jirayu Sitanurak* (Mahidol University) performed simultaneous determination of iodide and creatinine in human urine, using an on-line pretreatment flow injection system. *Carlos Palomino* (University of the Balearic Islands) described metal-organic framework mixed-matrix disks as advanced supports for automated solid-phase extraction.

Sumonmarn Chaneam (Silpakorn University, Thailand) used a flow injection system with C_4D and colorimetric detection for simultaneous determination of urea and creatinine in urine. *Nattapong Chantipmanee* (Mahidol University) studied the effect of acceptor surface area on analytical sensitivity in zone-fluidic membraneless vaporization. *Chalermpong Saenjun* (Chiang Mai University) performed chromatographic analysis of purple rice bran tocotrienol and tocopherol for osteoporotic protective products. *Teerarat Pun-uam* (Thammasat University) developed a gas diffusion-flow injection system using Roselle (*Hibiscus sabdariffa* L.) extract for determination of sulfite in wines. *Sam-ang Supharoek* (Mahidol University) determined benzoyl peroxide by sequential injection analysis using natural reagent from pumpkin.

Applications

Melisa Rodas Ceballos (University of the Balearic Islands) determined dynamic lixivation of uranium and thorium from

phosphogypsum by an MSFIA-LOV system with detection by ICP-MS. *David Cocovi-Solberg* (University of the Balearic Islands) described on-line monitoring of readily leachable triazine residues in soils using automatic kinetic bioaccessibility assays as a front end to liquid chromatography. *Ana Azevedo* (University of Porto) reported on an automated acylase I assay for ionic liquids´ toxicity screening.

Eakkasit Punrat (Chulalongkorn University, Thailand) determined nickel(II) by ion-transfer to hydroxide medium using sequential injection-electrochemical analysis. *Patricia Peixoto* (University of Porto) determined fluoroquinolones in water by a programmable flow injection approach with fluorimetric detection. *Alba González* (University of the Balearic Islands) used a micro-SI system for the spectrophotometric bi-parametric determination of iron and copper in soil leachates.

7. Poster Sessions

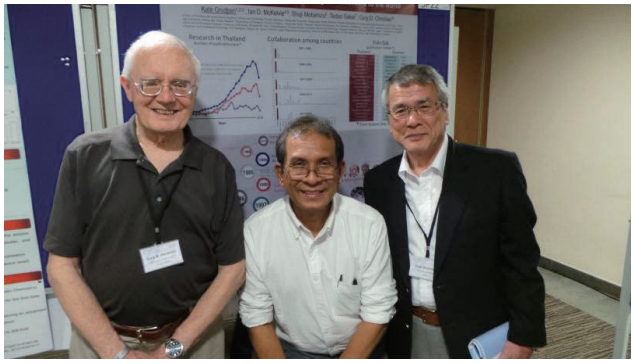
Posters were held in three sessions, following lunch on Monday, Tuesday, and Thursday afternoons, which were chaired by Elias Zagatto, Gary Christian, Luz Leal, José Costa Lima, Toshihiko Imato, António Rangel, Norio Teshima, Duangjai Nacapricha, and Aristidis Anthemidis. There were 87 posters. Presentations covered a broad spectrum of flow analysis topics, including fundamental studies, instrumentation, microfluidics, detection, on-line processing, and applications. There were contributions from Brazil (5), the Czech Republic (9), France (2), Greece (2), Japan (5), Mexico (3), Poland (12), Portugal (8), Russian Federation (1), Spain (20), Thailand (19), and Uruguay (1).

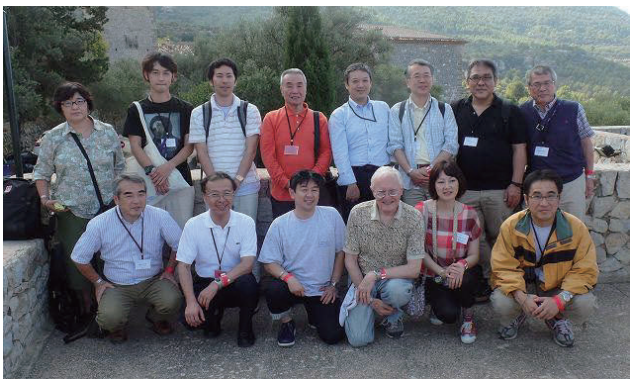
8. JAFIA Awards

The Japanese Association for Flow Injection Analysis presented, at the banquet, their prestigious FIA awards for 2016, consisting of a certificate and a medal. The **FIA Award for Science** was given to *Marcela Alves Segundo*, Professora Auxiliar, Department of Chemistry, Faculty of Pharmacy, University of Porto, Portugal for "Development of Flow-Based Systems for Automatic Sample Treatment and Antioxidant Assessment"

The **FIA Award for Young Researchers** was given to:
1) *Nathawut Choengchan*, Assistant Professor, Department of Chemistry, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand for "Cross Injection Analysis: Versatile Liquid Handling in Flow Injection-Based Technique"
2) *Kanchana Uraisin*, Lecturer, Department of Chemistry, Faculty of Science, Mahidol University, Thailand for "Newly Designed Flow-Based Chemical Analysis Method for Determination of Trace Halogen Compounds"
3) *Raquel Beatriz Ribeiro de Mesquita*, Ph.D., Universidade Católica Portuguesa, Porto, Portugal for "Development of Flow Analysis Methods as Sustainable Alternatives to Study Dynamic Environmental Systems"

The **FIA Award for Technical Development** was given to:
1) *Lukman Hakim* (Brawijaya Univ., Indonesia), *Shoji Motomizu* (Okayama Univ., Japan), *Keiro Higuchi* (M&G CHEMATechs Japan), *Tadao Sakai* (Aichi Institute of Technology, Japan) and *Norio Teshima* (Aichi Institute of Technology, Japan) for " Computer-Controlled High-Performance Solution Handling Systems and Their





Practical Applications"
2) *Sciware Systems* (Spain), President; Prof. *Víctor Cerdà*, Dr. *Laura Ferrer*, Dr. *Edwin Palacio*, Dr. *Sabrina Clavijo*, Ms. *Melisa Rodas*, and Ms. *Alba González* for "Development of Multi-Syringe Technology for Flow Analysis"

Our congratulations to all.

9. Award Ceremony of Best Oral and Poster Presentations

Certificates and a monetary award were given for each of the top three short oral presentations and poster presentations.

The winners for the short oral presentations were:
1) *Ana M.O. Azevedo*, LAQV, REQUIMTE, Universidade do Porto, Porto, Portugal for "Automated acylase I assay for ionic liquids´ toxicity screening"
2) *Nattapong Chantipmanee*, Mahidol University, Bankok, Thailand for "Effect of surface area of acceptor on analytical sensitivity in zone-fluidic membraneless vaporization"
3) *Sam-ang Supharoe*, Mahidol University, Amnat Charoen Campus, Amnat Charoen, Thailand for "Determination of Benzoyl Peroxide by a Sequential Injection Analysis using Natural Reagent from Pumpkin (*Cucurbita moschata*)"

The winners for the poster presentations were:
1) *Jorge Guzmán*, Universidad Autónoma de Nuevo León (UANL), Facultad de Ciencias Química, San Nicolás de los Garza, N.L., México for "On-line monitoring of Photo Electro-Fenton Process for asulam degradation"
2) *Aleksei Pochivalov*, Saint Petersburg State University, Saint Peteresburg, Russia for "A membrane microextraction based on switchable-hydrophilicity solvent. Automated determination of fluoroquinolones in food samples"
3) *Elodie Mattio*, Aix-Marseille University, LCE, Marseille, France for "3D printed system for the spectrophotometric determination of lead in water"

10. CASSS Travel Grants

The California Separation Science Society (CASSS) is a non-profit chromatography discussion group that sponsors international scientific symposia, including providing travel grants for young scientists. Five travel grants were awarded for this ICFIA and related techniques meeting, by Frantisek (Frank) Svec, an Associate Director and CASSS Distinguished Fellow. The awardees were:
1) *Júlia Lačná*, Masaryk University Brno, Czech Republic
2) *Raquel B. R. Mesquita*, Escola Superior de Biotecnologia, Portugal
3) *Michał Michalec*, University of Warsaw, Poland
4) *Phoonthawee Saetear*, Université de Montpellier, France
5) *Lucie Zelená*, Charles University Hradec Králové, Czech Republic

11. Sponsors/Exhibition

Corporate and foundation sponsors included: Sciware Systems, S.L. (www.sciware-sl.com), FIAlab (www.flowinjection.com), GlobalFIA (www.globalfia.com), DropSens (www.dropsens.com), and CASSS (www.casss.org).

12. Publication of the Proceedings

Papers for the conference will be submitted for peer review for a Virtual Special Issue of *Talanta*, with Guest Editor Victor Cerdà. Accepted papers will be published individually in regular issues, with a footnote to indicate at which conference the paper was presented, which will be used to link to the Virtual Special issue. In this manner, no manuscript publication delay will occur.

13. ICFIA 21

The International Steering Committee met on Tuesday evening to discuss the future of the conference. ICFIA 21 will be hosted by Andrey Bulatov of St. Petersburg State University, sponsored by the Russian Federation, to be held in St. Petersburg, Russia during September 3-8, 2017. Official invitations for visas will be issued. For information, contact Andrey at: bulatov_andrey@gmail.ru. The website for the conference is www.icfia2017.org.

It was also decided by the Steering Committee that ICFIA 22 will be held tentatively in early 2020, with the venue to be determined at the St. Petersburg meeting.