

## Matthias Kreuzer, PhD

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<https://anaesthesie.mri.tum.de/de/forschung/wissenschaftliche-arbeitsgruppen/ag-neuromonitoring-neuromonitoring-lab>

### EDUCATION

#### **Post-Doc, Computational Neuroscience, 2015-2017**

Emory University, Atlanta, GA, USA

Supervisor: Paul S García

#### **PhD, Experimental Medicine, 2006-2014**

Technische Universität München, Munich, Germany

Committee: Eberhard F. Kochs, Michael Schemann and Thomas Misgeld

*Evaluation of anesthetic-induced effects on cortical and subcortical neuronal network activity using advanced signal analytical approaches*

#### **M.Sc., Medical Engineering, 2003-2005**

Technische Universität München, Munich, Germany and University of Hawai'i at Manoa, HI, USA

Advisors: Erich Wintermantel and Daniel Jenkins

*Development of an electrochemical sensor to detect selected nucleic acid sequences on a disposable electrode*

#### **Dipl.-Ing., Electrical Engineering, 1998 - 2003 (M.Sc. equivalent) Technische Universität München, Munich, Germany**

Advisors: Alexander W. Koch and Achim Wack

*Development of a new algorithm for pulse oximeters and its implementation on a FPGA*

### EMPLOYMENT

#### **Principal Investigator: Neuromonitoring Lab, 11/2017–present**

Department of Anesthesiology and Intensive Care, Klinikum rechts der Isar, Technische Universität München, Munich, Germany

Head: Gerhard Schneider MD, PhD

- Correlation of EEG patterns and postoperative outcome
- Evaluation of EEG-based depth of anesthesia monitoring approaches
- Mechanisms of anesthesia on a neuronal network level
- Development and application of nonlinear and entropic analytical methods

#### **Postdoctoral Fellow, 05/2015–11/2017**

Neuroanesthesia Lab, Emory University, School of Medicine, Decatur, GA, USA

Head: Paul García, MD, PhD

- EEG patterns during emergence of anesthesia
- Association between intraoperative EEG patterns and adverse outcomes
- EEG characterization of the Cohen rat model for Alzheimer's disease

**Research Fellow**, 09/2005–04/2015

Department of Anesthesiology, Klinikum rechts der Isar, Technische Universität München, Munich, Germany

Head: Eberhard F. Kochs, MD, PhD

- Mechanisms of anesthesia on a neuronal network level
- Depth of anesthesia monitoring
- Sleep-stage evaluation

**Traineeship**, 3 months in 2002

Institute for Measurement Systems and Sensor Technology, Technische Universität München, Munich Germany

Programming in VHDL and C, realization and testing of a prototype pulse oximeter

**Traineeship**, 3 months in 2001

Jostra AG, Eresing, Germany

Setting up and conducting experiments for the risk analysis of a new ultrasound bubble sensor for a heart-lung machine

**PROFESSIONAL MEMBERSHIPS**

**ACCESS Group**, since 2013

*Anesthesiologists Concerned with Cognition, Emergence, Sleep, and Sedation*

Sponsored by the James S. McDonnell Foundation

**WAKWiN**, 2012–2015

*Wissenschaftlicher Arbeitskreis Wissenschaftlicher Nachwuchs*

Mentoring programme for successful young researchers of the German Society of Anesthesiology and Intensive Care Medicine

Mentor: Benno Rehberg-Klug, University of Geneva, Switzerland

- **DGAI**; German Society of Anesthesiology and Intensive Care Medicine
- **ESA**; European Society of Anesthesiology
- **SNACC**; Society for Neuroscience in Anesthesiology and Critical Care
- **ASA**; American Society of Anesthesiologists
- **IARS**; International Anesthesia Research Society

## COMMITTEES AND ASSIGNMENTS

**EEG for Anaesthesiology Boot Camp, 2022–present** *Core Member*

**ICPNT EEG intraoperative training / certification group, since 2022**

*International Council on Perioperative Neuroscience Training*

by the Society of Neuroscience in Anesthesiology and Critical Care (SNACC)

**ICE-TAP 2011–present** *Member of the Steering Committee of the International Consortium for EEG Training of Anesthesia Practitioners* <http://www.icetap.org>

## SKILLS

### Computational Skills

MATLAB, LabView, MS Office Suite, OpenOffice, C/C++, VBA, R Statistical Software, SigmaPlot, Inkscape, Vector Graphics, FreeMind, VHDL, PowerPCB, Eagle, Microcontroller Programming (Xilinx and Rabbit boards)

### Administrative Skills

Writing scientific papers

Writing grand proposals

Giving presentations

### Soft Skills (certified)

Time and self-management

Surviving complex projects

Conflict management

Leadership skills

## FURTHER INFORMATION

### Languages

German (mother tongue), English (fluent)

**Extracurricular Activities** 20 years of experience in coaching junior and senior sport teams (European team handball)

## RESEARCH COLLABORATIONS

### Departmental

**Thomas Fenzl, PhD**

**Stephan Kratzer, MD**

**Gerhard Rammes, PhD**

**Stefanie Pilge, MD**

### External

**Paul García, MD, PhD**

*Anesthesiology, Columbia University, New York City, NY, USA*

**Bernd Antkowiak, PhD and colleagues**

*Department of Anesthesiology and Intensive Care, Experimental Anesthesiology Section, Eberhard-Karls-Universität Tübingen, Tübingen, Germany*

**Jamie Sleigh MBChB, FANZCA, MD**

*Waikato Clinical School, Waikato Hospital, University of Auckland, Auckland, New Zealand*

**Darren Hight, PhD**

*Department of Anesthesiology and Pain Therapy, University Hospital of Bern, Switzerland*

**Odmara Barreto Chang, MD, PhD**

*Department of Anesthesia and Perioperative Care, School of Medicine, University of California, San Francisco, USA*

**Seyed Safavynia, MD, PhD**

*Department of Anesthesiology, New York Presbyterian Hospital-Weill, Cornell Medical College, New York, USA*

**Malte Anders**

*Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Germany*

**Sergio Vide, MD**

*Center for Clinical Research in Anesthesia, Servico de Anestesiologia, Centro Hospitalar do Porto, Porto, Portugal*

**Federico Linassi, MD**

*Department of Anesthesiology, University-Hospital of Padova, Padova, Italy*

**Pablo Sepúlveda, MD**

*Department of Anesthesiology, Clinica Alemana, Santiago, Chile*

**Falk von Dincklage, MD**

*Department of Anesthesiology, University of Greifswald, Greifswald, Germany*

**Carlo Jurth, MD**

*Department of Anesthesiology, Charité Berlin, Berlin, Germany*

**Sebastian Zinn, MD, PhD**

*Department of Anesthesiology, Goethe-University, Frankfurt am Main, Germany, Germany*

**Aeyal Raz, MD, PhD**

*Department of Anesthesiology, Neural Basis of Anesthesia Laboratory, Rambam Health Care Campus, Haifa, Israel*

**Andreas Körner, PhD**

*Department of Analysis and Scientific Computing, Technical University of Vienna, Austria*

**Jeff Ko, DVM**

*Department of Veterinary Clinical Sciences, Purdue University, Indiana, IN, USA*

**THESES**

**Dissertation**

*Analysis of anesthetic-induced effects on extracellular electrophysiological activity in cortical and subcortical neuronal networks*

**Master's Thesis: Medical Engineering**

*Electrochemical detection of DNA hybridization with a self-complementary ferrocene labelled oligonucleotide*

**Diploma Thesis: Electrical Engineering**

*Development of a control unit for a pulse oximeter and its algorithms to calculate SPO2 saturation and*

implementing the unit on a FPGA

(Original German title: *Entwicklung der Steuerung eines Pulsoximeters und den Algorithmen zur Berechnung der Sauerstoffsättigung, sowie deren Implementierung auf einem FPGA*)

## PUBLICATIONS

### 2022

Lutz R, Müller G, Dragovic S, Schneider F, Ribbe K, Anders M, Schmid S, García PS, Schneider G, **Kreuzer M**, Kratzer S *The absence of dominant alpha-oscillatory EEG activity during emergence from delta-dominant anesthesia predicts neurocognitive impairment- results from a prospective observational trial* JCA accepted for publication August 2022

corresponding author

Fleischmann A, Georgii MT, Schuessler J, Schneider G, Pilge S, **Kreuzer M** *Always assess the raw EEG: Why automated burst suppression detection may not detect all episodes* Anesth Analg online ahead of print doi: 10.1213/ANE.000000000000609

Chang OL, **Kreuzer M**, Morgen D, Possin KL, García PS *Ketamine Associated Intraoperative Electroencephalographic Signatures of Elderly Patients With and Without Preoperative Cognitive Impairment* Anesth Analg online ahead of print; doi: 10.1213/ANE.0000000000005875

Georgii MT, **Kreuzer M**, Fleischmann A, Schuessler J, Schneider G, Pilge S *Targeted interventions to increase blood pressure and decrease anaesthetic concentrations reduce intraoperative burst suppression: A randomised, interventional clinical trial* Front Syst Neurosci 2022, 16:786816; doi.org/10.3389/fnsys.2022.786816

Aulehner K, Bray J, Koska I, Pacel C, Palme R, **Kreuzer M**, Platt B, Fenzl T, Potschka H *The impact of tethered recording techniques on activity and sleep patterns in rats* Scientific Reports 2022, 12(1):3179; doi: 10.1038/s41598-022-06307-3

Linassi F, Maran E, De Laurenzis A, Tellaroli P, **Kreuzer M**, Schneider G, Navalesi P, Carron M *Targeted temperature management in cardiac surgery: a systematic review and meta-analysis on postoperative cognitive outcomes* BJA 2022, 128 (1), 11-25; doi: 10.1016/j.bja.2021.09.042

### 2021

**Kreuzer M**, Kiel T, Ernst L, Lipp M, Schneider G, Pilge S *Evaluation of Anesthetic Specific EEG Dynamics during State Transitions between Loss and Return of Responsiveness* Brain Sci. 2021;12(1):37; doi: 10.3390/brainsci12010037

Obert D, Hight D, Sleight J, Kaiser H, García PS, Schneider G, **Kreuzer M** *The first derivative of the electroencephalogram facilitates tracking of electroencephalographic alpha band activity during general anesthesia* Anesth Analg 2021 Oct 22. doi: 10.1213/ANE.0000000000005783

Linassi F, Obert DP, Maran E, Tellaroli P, **Kreuzer M**, Sanders RD, Carron M  
*Implicit Memory and Anesthesia: A systematic Review and Meta-Analysis*  
Life 2021, 11, 850; doi.org/10.3390/life11080850

Hofmann C, Sander A, Wang XX; Buerge M, Jungwirth B, Borgstedt L, **Kreuzer M**, Schorpp K, Hadian K, Wotjak C, Ebert T, Ruitenber M, Parsons CG, Rammes G  
*Inhalational anesthetics do not affect Amyloid-beta-derived pathophysiology in Alzheimer's disease: investigations on the molecular, neuronal and behavioral level*  
J Alzheimers Dis 2021 Oct 13; doi: 10.3233/JAD-201185

Obert D, Killing D, Happe T, Altunkaya A, Schneider G, **Kreuzer M**, Fenzl T  
*Combined implanted central venous access and cortical recording electrode array in freely behaving mice*  
MethodsX 2021, 101466; doi.org/10.1016/j.mex.2021.101466

Weyer C, Prötzl, E, Kinatader T, Nowak F, Husemann C, Hautmann H, Kratzer S, Schneider G, **Kreuzer M**  
*The Strength of Alpha Oscillations in the Electroencephalogram Differently Affects Algorithms used for Anesthesia Monitoring*  
Anesth Analg 2021 Dec 1;133(6):1577-1587. doi: 10.1213/ANE.0000000000005704

Obert DP, Schweizer C, Zinn S, Kratzer S, Hight D, Sleigh J, Schneider G, García PS, **Kreuzer M**  
*The influence of age on EEG-based anaesthesia indices*  
Journal of Clinical Anesthesia 2021,73:110325a; doi: 10.1097/ACO.0000000000000677  
*featured by editorial*

Fritz EM, **Kreuzer M**, Altunkaya A, Schuler C, Singewald N, Fenzl T  
*Altered sleep behavior in a mouse model of impaired fear extinction*  
Scientific reports 2021, 11:8978; doi.org/10.1038/s41598-021-88475-2

Schwerin S, Kopp C, Schneider G, **Kreuzer M**, Haseneder R, Kratzer S  
*Attenuation of Native Hyperpolarization-Activated, Cyclic Nucleotide-Gated Channel Function by the Volatile Anesthetic Sevoflurane in Mouse Thalamocortical Relay Neurons*  
Frontiers in Cellular Neuroscience, 2021 14:606687; doi: 10.3389/fncel.2020.606687

Zanner R, Schneider G, Meyer A, Kochs EF, **Kreuzer M**  
*Time delay of the qCON monitor and its performance during state transitions*  
J Clin Monit Comput, 2021,35(2):379-386. doi: 10.1007/s10877-020-00480-4

## 2020

Linassi F, **Kreuzer M**, Zanatta P, Maran E, Entilli L, Farnia A, Carron M  
*Age influences on Propofol estimated brain concentration and Entropy during maintenance and at return of consciousness during Total Intravenous Anesthesia With Target-Controlled Infusion in Unparalyzed Patients: an Observational Prospective Trial*  
PLOSone 2020, 15(12):e0244145 doi:10.1371/journal.pone.0244145

**Kreuzer M**, Keating GL, Härtner L, Sinon CG, Hajjar I, Ciavatta V, Fenzl T, Rye DB, Cohen R, García PS  
*Sleep/Wake Behavior and EEG Signatures of the TgF344-AD Rat Model at the Prodromal Stage*  
International Journal of Molecular Sciences 2020, 21, 9290; doi:10.3390/ijms21239290

Anders M, Anders B, **Kreuzer M**, Zinn S, Walter C *Application of referencing techniques in EEG-based Recordings of Contact Heat Evoked Potentials (CHEPS)*  
Front Hum Neurosc, 2020, 14:559969; DOI: 10.3389/fnhum.2020.559969

Kratzer S, Schneider G, García PS, **Kreuzer M**  
*Age-Related EEG features of Bursting Activity During Anesthetic-Induced Burst Suppression*  
Front. Syst. Neurosci, 2020, 14:599962; DOI: 10.3389/fnsys.2020.599962

Obert DP, Sepulveda P, Schneider G, **Kreuzer M**  
*The influence of induction speed on the frontal (processed) EEG*  
Scientific Reports, 2020, 10:19444; DOI: 10.1038/s41598-020-76323-8

von Dincklage F, Jurth C, García PS, Schneider G, **Kreuzer M**  
*Technical considerations when using the EEG export of the SEDLine Root device*  
Journal of Clinical Monitoring and Computing ahead of print; DOI: 10.1007/s10877-020-00578-9

Georgii MT, Pilge S, Schneider G, **Kreuzer M**  
*State Entropy and Burst Suppression Ratio Can Show Contradictory Relations*  
European Journal of Anaesthesiology, 2020, 37(12):1084-1092; DOI: 10.1097/EJA.0000000000001312

**Kreuzer M**, Butovas S, García PS, Schneider G, Schwarz C, Antkowiak B, Drexler B *Propofol affects cortico-hippocampal interactions via beta3 subunit-containing GABAA receptors*  
International Journal of Molecular Sciences 2020, 21(16):5844; DOI: 10.3390/ijms21165844

**Kreuzer M**, Stern MA, Hight D, Berger S, Sleight JW, García PS  
*Spectral and Entropic Features Are Altered by Age in the Electroencephalogram in Patients Under Sevoflurane Anesthesia*  
Anesthesiology, 2020, 132(5):1003-1016; DOI: 10.1097/ALN.0000000000003182

Campos C, Calheiros J, **Kreuzer M**, Fernandes R, Pinto C, Seabra M, Vide S  
*Clinical implications of using non-invasive haemoglobin monitoring for red blood cell transfusion decision in hip arthroplasty*  
DOI: 10.1016/j.transci.2020.102770

## 2019

**Kreuzer M**, García PS, Brucklacher-Waldert V, Claassen R, Schneider G, Antkowiak B, Drexler B  
*Diazepam and ethanol differently modulate neuronal activity in organotypic cortical cultures*  
BMC Neuroscience 2019, 20, 58; DOI: 10.1186/s12868-019-0540-6

Buerge M, Kratzer S, Mattusch C, Parsons CG, **Kreuzer M**, Hoffmann C, Rammes G  
*The anaesthetic xenon partially restores an amyloid beta-induced impairment in murine hippocampal synaptic plasticity*  
Neuropharmacology 2019, 151:21-32; DOI: 10.1016/j.neuropharm.2019.03.031

Gaskell AM, Pullon R, Hight DF, Termaat J, Mans G, Voss LJ, **Kreuzer M**, Schmidt S, Kratzer S, Schneider G, García PS, Sleight J *Modulation of frontal EEG alpha oscillations during anaesthesia to improve early*

*neurocognitive recovery in older patients: a randomised controlled trial*  
Trials 2019, 20:146; DOI: 10.1186/s13063-019-3178-x

Hesse S, **Kreuzer M**, Hight D, Gaskell A, Davari P, Singh D, Taylor NB, Whalin MK, Lee S, Sleigh JW, García PS

*Association of electroencephalogram trajectories during emergence from anaesthesia with delirium in the postanaesthesia care unit: an early sign of postoperative complications*  
British Journal of Anaesthesia 2019, 122(5):622-634; DOI: 10.1016/j.bja.2018.09.016

Hight DF, Gaskell AD, **Kreuzer M**, Voss LJ, García PS, Sleigh JW  
*Transient electroencephalographic alpha power loss during maintenance anaesthesia*  
British Journal of Anaesthesia 2019, 122(5):635-642; DOI: 10.1016/j.bja.2018.11.029

## 2018

Fleischmann A, Pilge S, Kiel T, Kratzer S, Schneider G, **Kreuzer M**  
*Substance-specific differences in human electroencephalographic burst suppression patterns*  
Frontiers in Human Neuroscience 2018, 21(12):368; DOI: 10.3389/fnhum.2018.00368

Mees L, Fidler J, **Kreuzer M**, Fu J, Pardue MM, García PS  
*Faster emergence behavior from ketamine/xylazine anesthesia with atipamezole versus yohimbine*  
PLoS One. 2018, 13(10): e0199087.

Yang E, **Kreuzer M**, Hesse S, Davari P, Lee SC, García PS  
*Infrared pupillometry helps to detect and predict delirium in the post-anesthesia care unit*  
Journal of Clinical Monitoring and Computing 2018, 32(2):359-68

## 2017

Kratzer S, Mattusch C, García PS, Schmid S, Kochs EK, Rammes G, Schneider G, **Kreuzer M**, Haseneder R  
*Anesthetic influences on thalamocortical stimulus propagation differs between sevoflurane and propofol*  
Frontiers in Computational Neuroscience 2017; 11:109

**Kreuzer M**, Whalin MK, Hesse S, Riso MA, García PS  
*Anesthetic Management of a Patient with Multiple Prior Episodes of PACU Delirium*  
Anesthesia & Analgesia Case Reports 2017, 8(12):311-315

Müller JN, **Kreuzer M\***, García PS, Schneider G, Hautmann H  
*Monitoring depth of sedation –evaluating the agreement between the Bispectral Index, qCON and the Entropy Module’s State Entropy during flexible Bronchoscopy*  
Minerva Anestesiologica 2017, 83(6):563-573

Rammes G, Mattusch C, Wulff M, Seser F, **Kreuzer M**, Zhu K, Deussing J, Herms J, Parsons C  
*Involvement of NR2B subunit containing N-methyl-D-aspartate (NMDA) receptors in mediating the acute and chronic synaptotoxic effects of oligomeric amyloid-beta (A-beta) in murine models of Alzheimer’s disease (AD)*  
Neuropharmacology 2017, 123:100-115



Härtner L, Keil TWM, **Kreuzer M**, Fritz EM, Wenning GK, Stefanova N, Fenzl T  
*Distinct Parameters in the EEG of the PLP alpha-SYN Mouse Model for Multiple System Atrophy reinforce Face Validity*  
Frontiers in Behavioral Neuroscience 2017; 10: 252

## 2016

Safavynia SA, Keating G, Spiegel I, Fidler JA, **Kreuzer M**, Rye DB, Jenkins A, García PS  
*The effects of GABA(A) receptor modulation by flumazenil on emergence from general anesthesia*  
Anesthesiology 2016; 125(1): 147-58

Schulz CM, Krautheim V, Hackemann A, **Kreuzer M**, Kochs EF, Wagner KJ  
*Situation awareness errors in anesthesia and critical care in 200 cases of a Critical Incident Reporting System*  
BMC Anesthesiology 2016; 16:4

## 2015

Whalin M, **Kreuzer M**, Halenda K, García P  
*Missed Opportunities for Intervention in a Patient with Prolonged Postoperative Delirium*  
Clinical Therapeutics 2015; 37:2706-10

**Kreuzer M\*\***, Polta S, Gapp J, Schuler C, Kochs EF, Fenzl T  
*Sleep scoring made easy—Semi-automated sleep analysis software and manual rescoring tools for basic sleep research in mice*  
MethodsX 2015; 2:232-40

Mattusch C, Kratzer S, Buerge M, **Kreuzer M**, Engel T, Kopp C, Biel M, Hammelmann V, Ying S-W, Goldstein PA, Kochs E, Haseneder R, Rammes G  
*Impact of Hyperpolarization-activated, Cyclic Nucleotide-gated Cation Channel Type 2 for the Xenon-mediated Anesthetic Effect: Evidence from In Vitro and In Vivo Experiments*  
Anesthesiology 2015; 122(5):1047-59

Pilge S, **Kreuzer M\***, Karatchiviev V, Kochs EF, Malcharek M, Schneider G  
*Differences between state entropy and bispectral index during analysis of identical electroencephalogram signals: A randomised comparison of two anaesthetic techniques*  
European Journal of Anaesthesiology 2015; 32(5):354-65

## 2014

Pilge S, Jordan D, **Kreuzer M**, Kochs EF, Schneider G  
*Burst suppression-MAC and burst suppression-CP50 as measures of cerebral effects of anaesthetics* British Journal of Anaesthesia 2014; 112(6):1067-74 <sup>1</sup>

Schneider G, Jordan D, Schwarz G, Bischoff P, Kalkman CJ, Kuppe H, Rundshagen I, Omerovic A, **Kreuzer M**, Stockmanns G, Kochs EF  
*Monitoring depth of anesthesia utilizing a combination of electroencephalographic and standard measures*

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<sup>1</sup>Society for Neuroscience in Anesthesiology and Critical Care "Article of the Month" 07/2017

Anesthesiology 2014; 120(4):819-28

**Kreuzer M**, Kochs EF, Schneider G, Jordan D

*Non-stationarity EEG during wakefulness and anaesthesia: advantages of EEG permutation entropy monitoring*

Journal of Clinical Monitoring and Computing 2014; 28:573-80

**Kreuzer M**, Jordan D, Antkowiak B, Drexler B, Kochs EF, Schneider G

*Brain electrical activity obeys Benford's Law*

Anesthesia & Analgesia 2014; 118(1):183-91

### 2013

Drexler B, **Kreuzer M\***, Jordan D, Antkowiak B, Schneider G

*Sevoflurane-induced loss of consciousness is paralleled by a prominent modification of neural activity during cortical down-states*

Neuroscience Letters 2013; 548:149-54

Mayer V, Schulz CM, **Kreuzer M**, Wagner KJ, Schneider G, Kochs EF

*Cardiopulmonary resuscitation performance during simulator-based trainings – a comparative retrospective analysis of adherence to 2005 and 2010 guidelines*

Minerva Anestesiologica 2013; 79(3):264-73

### 2012

**Kreuzer M**, Zanner R, Pilge S, Paprotny S, Kochs EF, Schneider G

*Time delay of monitors of the hypnotic component of anesthesia: analysis of state entropy and index of consciousness*

Anesthesia & Analgesia 2012; 115(2):315-9

Kellermann K, **Kreuzer M\***, Omerovich A, Hoetzinger F, Kochs EF, Jungwirth B

*A mobile phone based alarm system for supervising vital parameters in free moving rats*

BMC Research Notes 2012; 5:119

Pilge S, **Kreuzer M\***, Kochs EF, Zanner R, Paprotny S, Schneider G

*Monitors of the hypnotic component of anesthesia – correlation between bispectral index and cerebral state index*

Minerva Anestesiologica 2012; 78(6):636-45

### 2011

Schulz C, Mayer V, **Kreuzer M**, Kochs EF, Schneider G

*A tool for immediate and automated assessment of resuscitation skills for a full-scale simulator*

BMC Research Notes 2011; 4(1):550

Pilge S, Blum J, Kochs EF, Schöniger SA, **Kreuzer M**, Schneider G

*Does the Cerebral State Index separate consciousness from unconsciousness?*

Anesthesia & Analgesia 2011; 113(6):1403-10

## 2010

**Kreuzer M**, Hentschke H, Antkowiak B, Schwarz C, Kochs EF, Schneider G  
*Cross-approximate entropy of cortical local field potentials quantifies effects of anesthesia –a pilot study in rats*  
BMC Neuroscience 2010; 11(1):122

## 2009

Zanner R, Pilge S, Kochs EF, **Kreuzer M**, Schneider G  
*Time delay of electroencephalogram index calculation: analysis of Cerebral State, Bispectral, and Narcotrend indices using perioperatively recorded electroencephalographic signals*  
British Journal of Anaesthesia 2009; 103(3):394-99

## 2007

**Kreuzer M**, Kochs EF, Pilge S, Stockmanns G, Schneider G  
*Construction of the electroencephalogram player: A device to present electroencephalogram data to electroencephalogram-based anesthesia monitors*  
Anesthesia & Analgesia 2007; 104(1):135-39

## 2006

Pilge S, Zanner R, Schneider G, Blum J, **Kreuzer M**, Kochs EF  
*Time Delay of Index Calculation: Analysis of Cerebral State, Bispectral, and Narcotrend Indices*  
Anesthesiology 2006; 104(3):488-94

Jenkins D, Chami B, **Kreuzer M**, Presting G, Alvarez A, Liaw BY  
*Hybridization probe for femtomolar quantification of selected nucleic acid sequences on a disposable electrode*  
Analytical Chemistry 2006; 78 (7):2314 -2318

## 2004

Schneider G, Kochs EF, Horn B, **Kreuzer M**, Ningler M  
*Narcotrend does not adequately detect the transition between awareness and unconsciousness in surgical patient*  
Anesthesiology 2004; 101:1105-11

## OTHER PUBLICATIONS

### Review Articles

García PS, **Kreuzer M**, Height D, Sleigh JW  
*A Narrative Review of the Effects of Noxious Stimulation on the Electroencephalogram during General Anaesthesia*  
British Journal of Anaesthesia 2021; 126(2):445-457

## **Editorials, Comments, etc**

Berger M, Mark J, **Kreuzer M**

*Of Parachutes, Speedometers, and EEG- What evidence do we need to use Devices and Monitors?*  
Anesthesia & Analgesia 2020; 130 (5), 1274-1277; DOI: 10.1213/ANE.0000000000004653

Linassi F, **Kreuzer M**

*Book Review: General anesthesia research (1st edition)*  
Anesthesia & Analgesia: Volume 131(1), e13-e14; DOI: 10.1213/ANE.0000000000004824

**Kreuzer M**

*EEG based monitoring of general anesthesia: Taking the next steps*  
Frontiers in Computational Neuroscience 2017; 11: 56; DOI: 10.3389/fncom.2017.00056

## **Letters and Extended Abstracts**

Linassi F, Zanatta P, **Kreuzer M**, Mazzarolo AP, Rosellini E, Maran E, Carron M

*Intraoperative electroencephalographic burst suppression may help to indentify patients at risk for long-term adverse outcome: Findings from a homozygous twins case*  
Anaesthesia Critical Care & Pain Medicine 2020; DOI: 10.1016/j.accpm.2019.12.012

**Kreuzer M**, Schneider G

*Monitoring der Narkosetiefe - Welche Zielwerte optimieren das Behandlungsergebnis?*  
Journal für Anästhesie und Intensivbehandlung 2019-2, 29. Symposium Intensivmedizin + Intensivpflege  
Bremen; Herausgeber: R. Dembinski, H. Gerlach, K. Hankeln, W. Herbrand, W. Kuckelt, A. Weyland:  
ISSN 0941-4223

**Kreuzer M**, Schneider G, García PS

*Letter to the editor: The input is reflected in the output: evaluating neurophysiologic monitors with simulated data*  
Anesthesia & Analgesia 2017; 124(5):1734-5

Safavynia SA, Keating G, Spiegel I, Fidler JA, **Kreuzer M**, Rye DB, Jenkins A, García PS

*A Rising Tide Lifts All Boats: Increased Ventilation May Be Involved in Accelerated Recovery from Isoflurane Anesthesia after Flumazenil Administration*  
Anesthesiology 2017; 126(2): 352-53

**Kreuzer M**, Schneider G, García PS

Comment to *Large increases in both response and state entropy to awake values antagonized with administration of incremental rocuronium*  
Br J Anaesth published online January 19, 2016

## **Editorial Assignments**

2020-2021 Guest Associate Editor for Frontiers in Systems Neuroscience

*General Anesthesia: Neurobiological Underpinnings of Individual Cognitive Patient Outcome*

## **Ad Hoc Reviewer**

### **Journals**

2022–present Frontiers in Neuroinformatics  
2022–present Frontiers In Aging Neuroscience  
2022–present Critical Care Nurse  
2021–present Journal of Clinical Anesthesia  
2021–present Frontiers in Pharmacology  
2021–present BMC Pediatrics  
2020–present Brazilian Journal of Anesthesiology  
2020–present BioMedical Engineering OnLine  
2020–present Journal of Integrative Neuroscience  
2020–present Neurophysiologie Clinique  
2019–present Clinical Interventions in Aging  
2019–present Scientific Reports  
2019–present Communications Biology  
2019–present Journal of International Medical Research  
2019–present NeuroImage  
2019–present Journal of Neuroscience Methods  
2018–present PLOSone  
2018–present Anesthesiology  
2018–present Anesthesia & Analgesia and A&A Practice  
2018–present BMC Anesthesiology  
2017–present Complexity  
2017–present Frontiers in Systems Neuroscience  
2016–present British Journal of Anaesthesia  
2015–present Journal of Clinical Monitoring and Computing

### **Conferences**

2022 MATHMOD 2022, 10th Vienna International Conference on Mathematical Modelling  
2019 Int. Anesthesia Research Society, Annual Meeting  
2018 Int. Conference on Biological Information and Biomedical Engineering (VDE, IEEE)

### **Funding Agencies**

2021 French National Research Agency (ANR)  
2022 The Neurological Foundation (New Zealand)

### **INTERVIEWS**

05/2019 On: *EEG-Guided Anesthesia Does Not Lessen Incidence of Post-op Delirium* in Anesthesiology News  
10/2019 On: *Focusing on Spectrogram May Be Best Strategy to Reduce Unintended Awareness During Cardiac Surgery* in Anesthesiology News

## **(INVITED) TALKS**

11/2021 *Interpretation des EEG zur Narkose (für nicht-Neurologen)*

32. HerTA - Herforder Thesen Anästhesiologie

Herford, Germany, (virtual)

11/2021 *What do we really require from an EEG monitor in anesthesia?*

Chilean Society of Anesthesiology Annual Meeting, Santiago, Chile, (virtual)

09/2021 *Nicht zu viel, nicht zu wenig: Wieviel Monitoring brauchen wir für... das Gehirn?*

Hauptstadtkongress für Anästhesiologie und Intensivtherapie, Berlin, Germany, (virtual)

10/2019 *Perioperative EEG monitoring and outcome: opportunities and struggles*

RIPS@DRIPPS, University of Pennsylvania, Philadelphia, USA

9/2019 *Burst Suppression bei Patienten: Gemeinsamkeiten, Unterschiede und der ganze Rest*

Neurowoodstock Meeting at the Capital City Conference, Berlin, Germany

8/2019 *What we know and what we think we know about BS*

ACCESS 2019 Group Meeting, Hahei, New Zealand

5/2019 *Changes in the EEG with (cognitive) age*

Columbia University, NYC, USA

5/2019 *Age affects the architecture of the EEG under general anesthesia*

2018 Neuroscience Symposium "Effects of Anesthetics on the Brain", Montreal, CAN

5/2019 *Prozessiertes EEG und Narkosetiefe*

Deutscher Anästhesiegress, Leipzig, Germany

5/2019 *Veränderungen des EEG beim alten Patienten*

Deutscher Anästhesiegress, Leipzig, Germany

2/2019 *Monitoring der Narkosetiefe - Welche Zielwerte optimieren das Outcome?*

29. Symposium Intensivmedizin + Intensivpflege, Bremen, Germany

11/2018 *Perioperatives EEG Monitoring: Forschungsschwerpunkte und Studien*

Departmental Research Retreat, Kloster Seeon, Germany

11/2018 *Haben wir einen Nutzen von intraoperativem Narkosetiefe-Monitoring?*

Anästhesietage Berlin Brandenburg Sachsen Sachsen-Anhalt Thüringen, Leipzig, Germany

9/2018 *EEG Signatures des Alterns und kognitiver Einschränkungen*

Neurowoodstock Meeting at the Capital City Conference, Berlin, Germany

4/2018 *How to derive the information from the EEG*

2018 IARS Annual Meeting, Chicago, IL, USA

- 4/2018 *Early-stage Alzheimer's decreases post-anesthesia sleep in a rat model*  
2018 Neuroscience Symposium "Effects of Anesthetics on the Brain", Chicago, IL, USA
- 10/2017 *Compatibility, Accessibility, and Analysis Challenges in Multi-Center Patient Databases*  
ACCESS 2017 Group Meeting, Atlanta, GA, USA
- 05/2017 *Weak EEG alpha-power during general anesthesia as a marker of delirium in the PACU*  
AUA 64th Annual Meeting, Washington DC, USA
- 01/2017 *Using the EEG as a window into the patient's brain during anesthesia*  
Neuroscience Institute Lecture Series, GSU, Atlanta, GA, USA
- 02/2016 *Anesthesia: sinking into oblivion and back*  
Biology Undergraduate Research Seminar Series, GSU, Atlanta, GA, USA
- 02/2016 *Alpha-theta coupling and interhemispheric synchrony peri-emergence*  
ACCESS 2016 Group Meeting, Queenstown, New Zealand
- 06/2015 *Modulation of thalamocortical afferent signals by sevoflurane*  
9th International conference on Mechanisms of Anaesthesia, Bonn, Germany
- 09/2014 *Further, MATLAB-based analysis of VSDI experiments in acute slices —will this provide us with additional findings? (Original German title: Weiterführende MATLAB basierte Auswertung von VSDI Experimenten im akuten Schnitt – bringt uns das zusätzliche Erkenntnisse?)*  
UCM Meeting at the Capital City Conference, Berlin, Germany
- 04/2014 *Neuroelectrophysiological changes at different levels of anesthesia*  
93rd Annual Meeting of the German Physiological Society, Mainz, Germany
- 11/2013 *Evaluation of anesthetic-induced effects on electrophysiological activity in cortical and subcortical neuronal networks*  
SFB-F44 Seminars, Center for Chemistry and Biomedicine, Innsbruck Medical University, Innsbruck, Austria
- 09/2013 *Can we measure consciousness by means of electrophysiological monitoring?*  
ACCESS 2013 Group Meeting, Oxford, UK
- 04/2012 *Propofol-induced EEG alterations during state transitions (Original German title: Propofol-induzierte EEG Veränderungen während der State Transitions)*  
Neurowoodstock Meeting, Mainz, Germany
- 12/2011 *Developing the AMI, a multivariate index to measure the depth of anesthesia –current status of electrophysiological monitoring (Original German title: Entwicklung des multivariaten Narkosetiefe-Monitors AMI - Aktueller Stand des elektrophysiologischen Monitorings)*  
Workshop for the EU project "InTraMed C2C", Munich, Germany
- 09/2012 *The EEG player: testing platform to evaluate indexes to measure depth of anesthesia; design and results (Original German title: Der EEG-Player: Prüfstand zur Evaluierung von Narkosetiefe-Monitoren;*

*Aufbau und Ergebnisse)*

UCM Meeting at the Capital City Conference, Berlin, Germany

09/2011 *Current status of electrophysiological monitoring of general anesthesia (Original German title: Aktueller Stand des elektrophysiologischen Monitorings der Anästhesie)*

UCM Meeting at the Capital City Conference, Berlin, Germany

05/2011 *Developing the AMI, a multivariate monitor to measure the depth of anesthesia (Original German title: Entwicklung des multivariaten Narkosetiefe-Monitors AMI)*

TUM Technology Entrepreneurship Lab, Munich, Germany

04/2011 *Analysis of anesthesia effects by means of entropy measures (Original German title: Analyse von Anästhetika-Effekten mittels Entropiemasse)*

Neurowoodstock Meeting, Mainz, Germany

04/2011 *Using bivariate entropy measures for LFP and EEG analysis (Original German title: Anwendung bivariater Entropieparameter bei LFP und EEG)*

UCM Meeting, Hannover, Germany

05/2009 *Global and local modulation of cortical networks through anesthetic gases: an analysis of multichannel EEG and LFP with cross-approximate entropy (Original German title: Globale und lokale Modulation kortikaler Netzwerke durch Inhalationsanästhetika: Eine Analyse von Mehrkanal-EEG und LFP mit Cross-Approximate Entropy)*

Neurowoodstock Meeting, Mainz, Germany; w/ Harald Hentschke

03/2009 *Using cross-approximate entropy as an indicator of how cortical networks react to the use of anesthetic gases (Original German title: Cross-Approximate Entropy als Indikator der Reaktion kortikaler Netzwerke auf Inhalationsanästhetika)*

UCM Meeting, Munich, Germany; w/ Harald Hentschke

## **EDUCATIONAL LECTURES/TUTORIALS**

02/2021 *Fundamental Statistics - How to better understand scientific data!*

Institutional PhD Seminar, Department for Anesthesiology and Intensive Care, TU Munich

10/2020 *Statistische Grundlagen für das bessere Verständnis von Forschungsergebnissen*

Institutional Resident Seminar, Department for Anesthesiology and Intensive Care, TU Munich

2018-2020 *Cortex Organization / Brain Oscillations / Brain Death, Coma, etc.*

Cognitive Neuroscience Course, TU Munich

06/2019 *EEG, anesthesia, and age*

Pathophysiology of Circuits and Systems Course, Methods and Mechanisms in Anesthesia Seminar, TU Munich

11/2018 *EEG Signaturen des biologischen und funktionellen Alters*

Donnerstags-Fortbildung, Klinik für Anesthesiologie, Klinikum rechts der Isar der TUM, Munich, Germany



10/2018 *EEG Trajectories during Anesthesia Emergence are Associated with Delirium in the Post-Anesthesia Care Unit*

EEG Research Meeting, Department for Anesthesiology, TU Munich

2018-2019 *Statistics Workshop*

International Summer School WAKWIN, TU Munich

04/2018 *Influence of age and cognitive status on the EEG*

EEG Research Meeting, Department of Anesthesiology, TU Munich

12/2017 *What can the EEG tell us about the brain?*

PhD Seminar for Experimental Anesthesiology, Department of Anesthesiology, TU Munich

04/2017 *Quantitative EEG: General Analysis and Concepts*

Biology 450/IBS 534, Emory University

02/2017 *EEG and Synchrony*

IBS 514, Cellular and Developmental Neuroscience, Graduate Division of Biological and Biomedical Sciences, Emory University

09/2016 *Membrane potentials*

EUSOM c12020 (M1), Emory University School of Medicine

03/2016 *MATLAB tutorial: Introduction to Quantitative EEG Analysis Methods for Determining Transitions in Consciousness*

Emory University, Department of Biology, Journal Club

2006-2010 *Biosignal Processing*

Bioengineering Course, Technische Universität München, Munich, Germany

## **CONFERENCES**

### **Honors**

Postdoc Research Symposium, Outstanding Oral Presentation (2017)

Emory University, Atlanta, GA, USA

Margaret Wood Resident Research Award (2017)

Association of University Anesthesiologists Annual Meeting, Washington DC, USA

Best of Abstract (Co-author): "Clinical Science" (2016)

American Society of Anesthesiologists Annual Meeting, Chicago, IL, USA

Poster Award (Co-author): "Basic Science" (2016)

Society for Neuroscience and Critical Care Annual Meeting, Chicago, IL, USA

Best of Abstract: "Basic Science" (2015)

American Society of Anesthesiologists Annual Meeting, San Diego, CA, USA

Best Abstract in Scientific Subcommittee "Neurosciences" (2014)  
Euroanaesthesia Congress ESA, Stockholm, Sweden

Poster Award in Section "Basic Science" (2012)  
Capital City Conference on Anesthesiology and Critical Care Medicine, Berlin, Germany

Poster Award in Section "Basic Science" (2011)  
Capital City Conference on Anesthesiology and Critical Care Medicine 2011, Berlin, Germany

## **SESSION MODERATIONS**

*Experimental Neurosciences: Cerebral Vasculature and Memory Mechanisms*  
Anesthesiology 2018 Meeting; San Francisco, CA, USA; w/ Xiaowen Bai

*Experimental Neurosciences: Cerebral Vasculature and Memory Mechanisms*  
Anesthesiology 2017 Meeting; Boston, MS, USA; w/ Robert A Whittington

*Monitoring I*  
SNACC 2014 Annual Meeting; New Orleans, LA, USA; w/ Antoun Koht

*Monitoring I*  
SNACC 2013 Annual Meeting; San Francisco, CA, USA; w/ Antoun Koht

*Clinical Science-Neuromonitoring I*  
SNACC 2012 Annual Meeting; Washington DC, USA; w/ Antoun Koht & Basil Matta

## **ORAL PRESENTATIONS**

4/2018 *Early-stage Alzheimer's decreases post-anesthesia sleep in a rat model*  
SNACC Symposium 2018, Chicago, IL

10/2017 *Isoflurane Exposure Affects Sleep Architecture in a Rat Model of Alzheimer's Disease*  
American Society of Anesthesiologists 2017 Annual Meeting, Boston, MS, USA

10/2015 *Xenon Affects the Thalamic Input in Cortical Layer IV and Attenuates Cortical Processing in Layer II/III: A VSDI in vitro Study*  
American Society of Anesthesiologists 2015 Annual Meeting, San Diego, CA, USA

10/2013 *Isoflurane prolongs the time lag of analytic LFP amplitudes between hippocampus and basolateral amygdala - results from pilot experiments*  
American Society of Anesthesiologists 2013 Annual Meeting, San Francisco, CA, USA

10/2011 *Propofol-induced change in information processing between neocortex and hippocampus*  
American Society of Anesthesiologists 2011 Annual Meeting, Chicago, IL, USA

## **PARTICIPATION IN EU PROJECTS**

### **Leonardo da Vinci: CRITICAL Project 2006–2009**

*Common Resources or Interactive Training of Intensive Care Staff at all Levels project*  
(2006-UK/06/B/F/PP-162\_512; funding amount 381,000 Euro)

Participating groups from Greece, Spain, and the UK

- Design and realization of interactive teaching material
- Conduction of test trials

### **Leonardo da Vinci: INSPIRE Project 2005 - 2008**

*Improving Nascent Skills to Produce Interactive Resource for Education*  
(2005-UK/05/B/F/PP-162\_305; funding amount 347,000 Euro)

Participating groups from France, Spain and the UK

- Design and realization of a virtual intensive care patient
- Conduction of test trials

## **WORKSHOPS**

### **Scientific Workshops: Contributing**

#### **Unincorporated Channel Meeting (1 day)**

Talk as contribution at each meeting

- Charité, Berlin, Germany (09/2011, 09/2012, 09/2014)
- Hannover Medical School, Hannover, Germany (04/2011)
- Klinikum Bogenhausen, Munich, Germany (03/2009)

**Neurowoodstock Meeting (1 day)** Talk as contribution at each meeting  
Johannes Gutenberg University Mainz, Mainz, Germany (04/11, 04/12)

#### **1st Baltic Autumn School (5 days)**

*Applied Computational Neuroscience: Sleep, Neuroengineering and Dynamics*

Poster presentation as contribution

University of Lübeck, Lübeck, Germany (09/2010)

### **Scientific Workshops: certified attendances**

#### **Scientific Skills - Statistics (3 days)**

*WAKWiN Science Skills Seminar*

Hotel Leonardo, Weimar, Germany (2013)

#### **How to Write a Paper Workshop (half day)**

SNACC Annual Meeting, Omni Shoreham, Washington DC, USA (2013)

#### **Funding (3 days)**

*WAKWiN Science Skills Seminar*

University Hospital Carl Gustav Carus, Dresden, Germany (2012)

#### **DFG Career Day (1 day)**

Institute for Advanced Study, Technische Universität München, Munich, Germany (2011)

## **Soft-Skill Seminars: Certified Attendances**

### **Leadership Skills (3 days)**

*WAKWiN Mentoring Seminar*

Fresenius Stiftung, Bad Homburg, Germany (2013)

### **Time Management is Self Management (2 days)**

*Carl von Linde Akademie*

Technische Universität München, Munich, Germany (2013)

### **Surviving Complex Projects (2 days)**

*Carl von Linde Akademie*

Technische Universität München, Munich, Germany (2013)

### **Conflict Management (2 days)**

*Carl von Linde Akademie*

Technische Universität München, Munich, Germany (2013)

## **THESIS- SUPERVISIONS**

Lang, Sophia

*Erkennen von postoperativen Verwirrheitszuständen anhand des EEGs der Aufwachphase*

Otto-von-Taube-Gymnasium Gauting, Germany (TUMKolleg, Seminar Thesis, 2021)

Jordan, Linda

*Examination of the relationship between pre- and intraoperative EEG alpha oscillation parameters in young and elderly adults* Faculty of Medicine at the Technical University of Munich (Master, 2020)

Maksimowicz, Olivia

*Relationship between Preoperative EEG Characteristics and EEG Burst Suppression - Identifying Baseline EEG Features Associated with Intraoperative EEG Patterns* Faculty of Medicine at the Technical University of Munich (Master, 2020)

Feng, Tianle

*Automated Detection of Electroencephalographic Burst Suppression in Patients under General Anesthesia*

Faculty of Biology, Ludwig-Maximilian-University of Munich, Germany (Bachelor, 2019)

Nowak, Fabian

*Konzeption und Entwicklung eines Analysetools für EEG-Daten*

Werner-Heisenberg-Gymnasium Garching, Germany (TUMKolleg, Seminar Thesis, 2019)

## **PATENTS**

García PS, **Kreuzer M**

*System, Method and Computer-Accessible Medium for Anesthesia Monitoring Using Electroencephalogram Monitoring*

US Patent App. 17/717,708, 2022

Berger S, García PS, **Kreuzer M**, Obert D, Schneider G

*System, Method and Computer-Accessible Medium for Visualization and Analysis of Electroencephalogram Oscillations in the Alpha Band*

US Patent App. 17/728,310, 2022

Kochs EF, Schneider G, Jordan D, Omerovic A, **Kreuzer M**

*Method and system for quantifying anaesthesia or a state of vigilance*

Patent numbers: WO2012171610 A1, EP2535000 A1, EP2720609 A1, US20140155706 A1

Munich, August 25, 2022

Dr. Matthias Kreuzer