Ivan S. Klyuzhin, PhD
Curriculum vitae

Postdoctoral Research Fellow
Department of Radiology
University of British Columbia

Research Programmer
BC Cancer Research Institute
Vancouver, BC, Canada 🇨🇦

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BC Cancer Research Institute
Integrative Oncology (6th floor)
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AREAS OF SPECIALIZATION

Technical: Medical image analysis, Image denoising and enhancement, Feature selection, Regularized regression, Dimensionality reduction, Artificial neural networks, Machine learning, Inverse problems and tomographic image reconstruction; **Medical:** Parkinson's disease, Neurodegeneration, Oncology, Dermatology, Generative disease models, Predictive modeling.

EDUCATION

Doctor of Philosophy   February 2017
Physics (Medical Physics specialization)
Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada
Thesis: Deformable motion correction and spatial image analysis in positron emission tomography
Available at: <https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0340673>

Bachelor's/Master's of Science Combined   July 2006
Physics (Medical Physics specialization)
Department of Bioengineering, University of Washington, Seattle, WA, USA
Department of Physics, Ural Federal University (Ural State University), Yekaterinburg, Russia

PROFESSIONAL EXPERIENCE

Microsoft, Redmond, WA
AI for Good Lab   (06/2020 – present)
Postdoctoral intern

- Implementation and testing of deep learning models for medical image segmentation and classification.
- Development of image synthesis methods based on generative adversarial networks.
- Data profiling, management and pre-processing.
- Facilitation of communication between radiologists and data scientists.

BC Cancer Research Institute / University of British Columbia, Vancouver, BC
BCCRI Department of Integrative Oncology   (11/2019 – present)
UBC Department of Radiology
Research programmer / Postdoctoral research fellow

- Development and implementation of machine learning methods and computational infrastructure for the provincial cancer screening program.

- Oversight and management of machine learning, image analysis, and bioengineering research projects.
- Image analysis and statistical analysis of prostate cancer and lymphoma PET/CT imaging studies.

University of British Columbia, Vancouver, BC

Department of Medicine, Division of Neurology   03/2017 – 10/2019
Postdoctoral research fellow
- Initiated and led several research projects that were focused on machine-learning based medical image analysis and enhancement: sparse regularized regression using PCA and LASSO, feature selection using generative disease models, 4D image enhancement using deep neural nets.
- Implemented multiple functions, scripts and pipelines in Matlab and Python (Numpy, Keras, Tensorflow).
- Regularly interacted with physicians (neurologists) to bring state-of-the-art image analysis methods to clinical research.
- Authored or co-authored multiple peer-reviewed publications and conference presentations.
- Interviewed and supervised co-op students, interns and prospective PhD students.
- Contributed to multiple domestic and international research collaborations.

Department of Physics and Astronomy   01/2010 — 02/2017
PhD student, Research/teaching assistant
- Developed, implemented and tested a new algorithm for tomographic image reconstruction using unorganized point clouds with Voronoi cell basis functions (Matlab, C++).
- Developed and implemented a new efficient algorithm for computing line–Voronoi cell intersections in N-D using a fast k–nearest neighbor search (C++).
- Implemented several experimental filters for medical image processing (C++).
- Pioneered application of texture and shape-based spatial image analyses in brain PET imaging; implemented efficient computation of Haralick texture features (Matlab).
- Characterized depth-sensing cameras and investigated several methods to denoise point cloud / depth data (Matlab).
- Developed a pipeline to generate animated, deformable digital phantoms of rodents and other small animals (Matlab, Python, Blender).
- Authored or co-authored original research articles that were published in top journals in the field (IEEE Transactions of Medical Imaging, Journal of Cerebral Blood Flow and Metabolism, Neuroimage).
- 3 years of teaching assistant experience, including two courses as head teaching assistant.

MITACS, Vancouver, BC

Globalink Research Program   04/2019 – 09/2019
International student mentor
- Provided health, safety, and psychological support for MITACS Globalink research interns.
- Facilitated interpersonal communication between the interns and their academic supervisors.
- Organized and facilitated regular meetings to assess the intern progress and well-being.

MetaOptima Technology Inc., Vancouver, BC   01/2014 – 09/2015
Computer vision engineer, R&D project manager
- Led the R&D effort to develop computer-vision algorithms for melanoma and skin cancer detection (C++, OpenCV).
- Developed a proprietary iOS/Web platform for 3D bodymap visualization and skin lesion mapping (Objective-C, WebGL, OpenGL ES).
- Managed and contributed to projects in image-based automated diagnosis, similarity image search and retrieval, image registration, shadow and artefact removal, contrast enhancement, object segmentation.
- Planned and coordinated regular R&D meetings with focus on clear timelines and measurable outcomes.
- Interacted with the senior management, front-end and back-end development teams, and clinical advisors to implement R&D solutions in market-ready products.
- Interviewed job applicants for the R&D engineer position.

- Presented company's research at international scientific conferences.
- Developed successful grant and fellowship applications (listed below).

University of Washington, Seattle, WA   08/2005 – 09/2009
Department of Bioengineering
Visiting scientist
- Biomaterials research: Developed a new technique to synthesize micrometer-size polymer gels.
- Investigated a hypothesis of neuronal signal transduction based on the phase transitions in polymer gels.
- Developed a biomaterial/solution characterization pipeline that included several analytical chemistry and material science techniques: osmometry, UV-VIS spectroscopy, ICP-mass spectrometry, fluorescent/optical/confocal microscopy, turbidity analysis, infrared imaging, Schlieren imaging.
- Developed and tested a novel microfluidic device for water purification: brought an experimental concept to a proof-of-principle prototype.
- Engineered and constructed an experimental video-tracking apparatus with integrated, programmable digital controller.
- Supervised a team of undergraduate students.

Ural State Research Institute for Traumatology and Orthopedics,
Yekaterinburg, Russia   09/2004 – 07/2005
Junior software engineer (part-time volunteer)
- Helped develop a responsive application interface for medical data entry.
- Designed and implemented custom XML schemas.
- Wrote an XML Schema parser and builder to encapsulate unstructured, archival medical data.

AWARDS AND ACHIEVEMENTS

- **1st Place poster** presentation award, Postdoctoral research day, University of British Columbia Postdoctoral Association, 2018 , Vancouver, BC, Canada
  ('Use of a 4D Deep Autoencoder to Denoise Dynamic PET Data')

- IEEE Medical Imaging Conference **trainee awards (refereed)** (2011, 2012, 2014, 2015, 2016, 2019)

- **Featured poster**, IEEE Medical Imaging Conference, 2015, San Diego, CA, USA
  ('Development of a Digital Unrestrained Mouse Phantom with Non-Periodic Deformable Motion')

- **2nd Place poster award** in Data analysis and Management, Society of Nuclear Medicine and Molecular Imaging Annual Meeting, 2013, Vancouver, BC, Canada
  ('Investigating the effect of inter-modality ROI shape on the correlation between clinical and image-derived data in PET studies of Parkinson's disease')

- University of British Columbia **graduate award** (2010-2014), Vancouver, BC, Canada

- Izakov's Award for Outstanding Student Work in the Field of Biological and Medical Physics (2004), Ural State University, Yekaterinburg, Russia

GRANT APPLICATIONS (FUNDED)

Canadian Institutes of Health Research (CIHR) Project Grant   09/2020 – 09/2025
Improved assessment of disease in lymphoma patients using Quantitative PET Imaging
Role: Co-applicant

Canadian Institutes of Health Research (CIHR) Project Grant   4/2019 - 3/2023
Quantitative PSMA Targeted Imaging of Prostate Cancer Patients
Role: Co-investigator

Canadian Institutes of Health Research (CIHR) Project Grant   12/2014 - 3/2021
Integrative Quantitative Imaging Methods and Genomic Biomarkers to Assess the Therapeutic Response of Cancers
Role: Co-investigator

Michael J. Fox Foundation Grant   09/2017 – 12/2017
Novel quantification paradigm in Parkinson's disease neurochemical imaging:
Application of deep learning techniques to DaTSCAN SPECT images to improve the prediction of early cognitive decline in Parkinson's disease.
Role: Co-author

Mitacs Accelerate Cluster Fellowship   06/2014 – 09/2015
Automated image analysis for smartphone-based skin cancer screening:
Deep learning based feature extraction, image search and retrieval, image registration, high and low-level handcrafted features.
Role: Co-author

NSERC Engage Fellowship   01/2014 – 06/2014
An interactive 3D visualization tool for personalized, mobile-based system for skin cancer screening
Role: Co-author

COMMUNITY ENGAGEMENT AND SERVICE

Student Mentor   09/2020 – present
Beedie Luminaries

Partnerships and Operations Lead   03/2019 – 01/2020
Data For Good Vancouver
Data for Good Vancouver Chapter
Provide pro bono data analytics services to registered charities, non-governmental and not-for-profit organizations.

Student Mentor   09/2018 – 03/2019
UBC Undergraduate research opportunities (REX), Research EXperience (REX) program
Project title: Training of deep convolutional neural nets to extract radiomic signatures of tumors (pdf).

Paper reviewer   03/2017 – present
Journals: IEEE Transactions on Radiation and Plasma Medical Sciences, Neuroimage: Clinical, Nuclear Instrumentation Methods in Physics Research, European Journal of Nuclear Medicine and Molecular Imaging
Subjects: Deep learning-based image enhancement, imaging instrumentation design, radiomics, predictive models.

Abstract reviewer   04/2016 – present
World Molecular Imaging Congress
Category: Computer Applications and Postprocessing.
NeurIPS
Machine Learning for Health Workshop

TECHNICAL EXPERTISE

Languages: Matlab, Python, C/C++, Objective-C (iOS Application framework), HTML, JavaScript (beginner), SQL (beginner).
Major libraries and frameworks: Tensorflow, Keras, Numpy, OpenCV, Eigen, OpenGL, WebGL.
Other: Blender, Microsoft Kinect API, TeX/LaTeX, ImageJ, Bash, AWS (beginner), LabView (beginner).

JOURNAL PUBLICATIONS

- *Klyuzhin*, I. S., Bevington, C., Cheng, J-C., Sossi, V. (2020). **Detection of transient neurotransmitter response using personalized neural networks**. Physics in Medicine and Biology, *early access*
  https://doi.org/10.1088/1361-6560/abc230

- Cheng, J.-C., Bevington, C., Rahmim, A., *Klyuzhin*, I., Matthews, J., Boellaard, R., Sossi, V. (2020). **Dynamic PET image reconstruction utilizing intrinsic data-driven 4D de-noising kernel**. Medical Physics, *in press.*

- Bevington, C., Cheng, J.-C., *Klyuzhin*, I., Cherkasova, M., Winstanley, C., Sossi, V. (2020). **A Monte Carlo approach for improving transient dopamine release detection sensitivity**. Journal of Cerebral Blood Flow and Metabolism, *early access.*
  https://doi.org/10.1177/0271678x20905613

- Fu, J. F., *Klyuzhin*, I. S., McKeown, M. J., Stoessl, A. J., Sossi, V. (2020) **Novel data-driven, equation-free method captures spatio-temporal patterns of neurodegeneration in Parkinson's disease: application of dynamic mode decomposition to PET**. NeuroImage: Clinical, 25, 102150.
  https://doi.org/10.1016/j.nicl.2019.102150

- Salmanpour, M. R., Shamsaei, M., Saberi, A., *Klyuzhin*, I. S., Tang, J., Sossi, V., Rahmim, A. (2020). **Machine learning methods for optimal prediction of motor outcome in Parkinson's disease**. Physica Medica, 69, 233-240.
  https://doi.org/10.1016/j.ejmp.2019.12.022

- *Klyuzhin*, I. S., Cheng, J-C., Bevington, C., Sossi, V. (2020). **Use of a Tracer-specific Deep Artificial Neural Net to Denoise Dynamic PET Images**. IEEE Transactions on Medical Imaging, 39(2), 366-376.
  https://doi.org/10.1109/TMI.2019.2927199

- Salmanpour, M. R., Shamsaei, M., Saberi, A., Setayeshi, S., *Klyuzhin*, I. S., Sossi, V., Rahmim. A. (2019). **Optimized Machine Learning Methods for Prediction of Cognitive Outcome in Parkinson's Disease**. Computers in Biology and Medicine, 111, 103347.
  https://doi.org/10.1016/j.compbiomed.2019.103347

- Sossi, V., Cheng, J.-C., *Klyuzhin*, I. S. (2019). **Imaging in neurodegeneration: movement disorders**. IEEE Transactions on Radiation and Plasma Medical Sciences, 3(3), 262-274.
  https://doi.org/10.1109/TRPMS.2018.2871760

- Fu, J. F., *Klyuzhin*, I. S., McKenzie, J., Neilson, N., Shahinfard, E., Dinelle, K., McKeown, M.J., Stoessl, A.J., Sossi, V. (2019). **Joint pattern analysis applied to PET DAT and VMAT2 imaging reveals new insights into Parkinson's disease induced presynaptic alterations**. NeuroImage: Clinical, 23, 101856.
  https://doi.org/10.1016/j.nicl.2019.101856

- Tang, J., Yang, B., Shenkov, N. N., *Klyuzhin*, I. S., Fotouhi, S., Davoodi-Bojd, E., Lu, L., Soltanian-Zadeh, H., Sossi, V., Rahmim, A. (2019). **Artificial neural network based prediction of outcome in Parkinson's disease patients using DaTscan SPECT imaging features**. Molecular Imaging and Biology, 21, 1165-1173.
  https://doi.org/10.1007/s11307-019-01334-5

- *Klyuzhin*, I. S., Fu, J. F., Shenkov, N., Rahmim, A., Sossi, V. (2019). **Use of Generative Disease Models for Analysis and Selection of Radiomic Features in PET**. IEEE Transactions on Radiation and Plasma Medical Sciences, 3(2), 178-191.
  https://doi.org/10.1109/TRPMS.2018.2844171

- Fu, J. F., *Klyuzhin*, I., Liu, S., Shahinfard, E., Vafai, N., McKenzie, J., . . . Sossi, V. (2018). **Investigation of serotonergic Parkinson's disease-related covariance pattern using [11C]-DASB/PET**. NeuroImage: Clinical, 19, 652–660.
  https://doi.org/10.1016/j.nicl.2018.05.022

- *Klyuzhin*, I. S., Fu, J. F., Hong, A., Sacheli, M., Shenkov, N., Matarazzo, M., . . . Sossi, V. (2018). **Data-driven, voxel-based analysis of brain PET images: Application of PCA and LASSO methods to visualize and quantify patterns of neurodegeneration**. PloS One, 13(11), e0206607.
  https://doi.org/10.1371/journal.pone.0206607

- *Klyuzhin*, I. S., Sossi, V. (2017). **PET Image Reconstruction and Deformable Motion Correction Using Unorganized Point Clouds**. IEEE Transactions on Medical Imaging, 36(6), 1263–1275.
  https://doi.org/10.1109/TMI.2017.2675989

- *Klyuzhin*, I. S., Gonzalez, M., Shahinfard, E., Vafai, N., Sossi, V. (2016). **Exploring the use of shape and texture descriptors of positron emission tomography tracer distribution in imaging studies of neurodegenerative disease**. Journal of Cerebral Blood Flow and Metabolism, 36(6), 1122–1134.
  https://doi.org/10.1177/0271678X15606718

- Rahmim, A., Salimpour, Y., Jain, S., Blinder, S. A. L., *Klyuzhin*, I. S., Smith, G. S., . . . Sossi, V. (2016). **Application of texture analysis to DAT SPECT imaging: Relationship to clinical assessments**. NeuroImage: Clinical, 12, e1–e9.
  https://doi.org/10.1016/j.nicl.2016.02.012

- O'Rourke, C., *Klyuzhin*, I., Park, J. S., Pollack, G. H. (2011). **Unexpected water flow through Nafion-tube punctures**. Physical Review E - Statistical, Nonlinear, and Soft Matter Physics, 83(5).
  https://doi.org/10.1103/PhysRevE.83.056305

- *Klyuzhin*, I. S., Ienna, F., Roeder, B., Wexler, A., Pollack, G. H. (2010). **Persisting water droplets on water surfaces**. Journal of Physical Chemistry B, 114(44), 14020–14027.
  https://doi.org/10.1021/jp106899k

- *Klyuzhin*, I., Symonds, A., Magula, J., Pollack, G. H. (2008). **New method of water purification based on the particle-exclusion phenomenon**. Environmental Science and Technology, 42(16), 6160–6166.
  https://doi.org/10.1021/es703159q

- Shklyar, T. F., Safronov, A. P., *Klyuzhin*, I. S., Pollack, G., Blyakhman, F. A. (2008). **A correlation between mechanical and electrical properties of the synthetic hydrogel chosen as an experimental model of cytoskeleton**. Biophysics, 53(6), 544–549.
  https://doi.org/10.1134/S0006350908060146

TALKS AND PRESENTATIONS

- Klyuzhin I. (2020). Novel image analysis methods in PET imaging driven by machine learning: their development and applications (**Invited**). Summer Student Medical Physics Symposium, University of Winnipeg, MB, Canada

- Klyuzhin I., Rahmim A. (2020). Overview of realities and challenges in PET/CT imaging (**Invited**). Microsoft AI for Health program, Redmond, WA, United States

- Klyuzhin I. (2019). Use of deep learning and physics simulations for personalized medical image enhancement. Deep Learning and Reinforcement Learning Summer School, Edmonton, AB, Canada

- Klyuzhin I, Cheng J-C. (2018). UBC PET Physics Program. TRIUMF Life sciences project evaluation committee meeting, Vancouver, BC, Canada

- Louadi S, Klyuzhin I, (2018). Movement and brain disorders through lens of medical imaging (**Invited**). Voirelia: Dance, Psychology and Philosophy Hub Presentation Night, Vancouver, BC, Canada

- Klyuzhin I, Sossi V. (2016). Nuclear Emission-based Imaging in the Study of Brain Function (**Invited**). Fall Meeting of the APS Division of Nuclear Physics, Vancouver, BC, Canada

CONFERENCE PUBLICATIONS

– **2020**

- R. Fedrigo, D. Kadrmas, P. Edem, L. Fougner, I. *Klyuzhin*, M. P. Petric, F. Bénard, A. Rahmim, C. Uribe, **Optimization of Quantitative [18F]DCFPyL PET using a Realistic Anthropomorphic Phantom with Shell-less Radioactive Epoxy Lesions**, Proc. Ann. European Association of Nuclear Medicine (EANM) Meeting, 2020, Vancouver, BC, Canada.

- D. Black, Y. Oloumi, J. Wong, R. Fedrigo, C. Uribe, D. Kadrmas, A. Rahmim, I. *Klyuzhin*, **Design and manufacture of anatomically realistic, actuated, elastic lung inserts for PET/CT phantom studies with respiratory motion**, 2020 Joint AAPM/COMP Annual meeting, 2020, Vancouver, BC, Canada.

- I. S. *Klyuzhin*, A. Rahmim, **Shape analysis in PET images using convolutional neural nets: limitations of standard architectures**, 2020 Joint AAPM/COMP Annual meeting, 2020, Vancouver, BC, Canada.

- J. G. Mannheim, J. F. Fu, T. Wegener, I. S. *Klyuzhin*, A. J. Stoessl, V. Sossi, **Multi-tracer PET joint correlation analysis reveals disease-specific patterns in both Parkinson's disease and asymptomatic LRRK2 mutation carriers compared to healthy controls**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), 2020, Montreal, Canada [*accepted, cancelled due to Covid-19*]

- J. F. Fu, I. S. *Klyuzhin*, T. Wegener, M. J. McKeown, A. J. Stoessl, V. Sossi, **Novel data-driven method captures spatio-temporal patterns of neurodegeneration in Parkinson's disease**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), 2020, Montreal, Canada [*accepted, cancelled due to Covid-19*]

- J. F. Fu, T. Wegener, I. S. *Klyuzhin*, J. G. Mannheim, M. J. McKeown, A. J. Stoessl, V. Sossi, **Distinct spatio-temporal patterns of putuminal dopamine processing in Parkinson's disease: a multi-tracer Positron Emission Tomography study**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), 2020, Montreal, Canada [*accepted, cancelled due to Covid-19*]

– **2019**

- I. S. *Klyuzhin*, C. Bevington, J.-C. Cheng, V. Sossi, **Identification of transient neurotransmitter response using anomaly detection framework**, 2019 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference, 2019, Manchester, United Kingdom.

- J.-C. Cheng, C. Bevington, I. *Klyuzhin*, V. Sossi, **Simultaneously improving accuracy and precision within dynamic kernelized PET reconstruction**, 2019 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference, 2019, Manchester, United Kingdom.

- J. F. Fu, M. Matarazzo, I. *Klyuzhin*, J.-C. Cheng, C. Bevington, J. McKenzie, N. Neilson, E. Shahinfard, M. J. McKeown, A. J. Stoessl, V. Sossi, **The serotonergic system plays a role in Levodopa-induced dopamine release and influences response to treatment in early Parkinson's disease**, International Congress of Parkinson's Disease and Movement Disorders, 2019, Nice, France.

- I. S. *Klyuzhin*, C. Bevington, J.-C. Cheng, V. Sossi, **Use of deep learning and physics simulations for personalized medical image enhancement**, Deep Learning and Reinforcement Learning Summer School, 2019, Edmonton, AB, Canada.

- J. Kim, S. Seo, S. Ashrafinia, A. Rahmim, V. Sossi, I. S. *Klyuzhin*, **Training of deep convolutional neural nets to extract radiomic signatures of tumors**, Society of Nuclear Medicine and Molecular Imaging (SNMMI) Annual Meeting, 2019, Anaheim, CA, USA.

- M. Matarazzo, I. *Klyuzhin*, J. A. Pineda-Pardo, Z. Anderson, J. McKenzie, N. Neilson, J. A. Obeso, V. Sossi, A. J. Stoessl, **Dopaminergic denervation in people with PD is higher in the striatal region corresponding to the upper limb**, World Parkinson Congress, 2019, Kyoto, Japan.

- M. R. Salmanpour, M. Shamsaee, A. Saberi Manesh, S. Setayeshi, I. S. *Klyuzhin*, V. Sossi, A. Rahmim, **Optimized machine learning methods for prediction of cognitive outcome in Parkinson's disease**, Society of Nuclear Medicine and Molecular Imaging (SNMMI) Annual Meeting, 2019, Anaheim, CA, USA.

- J. F. Fu, M. Matarazzo, I. *Klyuzhin*, B. Reber, J.-C. Cheng, C. Bevington, J. McKenzie, N. Neilson, E. Shahinfard, M. J. McKeown, A. J. Stoessl, V. Sossi, **Joint multimodal analysis revealed complementary spatial patterns of dopaminergic and serotonergic interactions related to levodopa response in parkinson's disease**, Brain & Brain PET 2019, Yokohama, Japan.

- J. F. Fu, I. *Klyuzhin*, J. McKenzie, N. Neilson, E. Shahinfard, K. Dinelle, M. J. McKeown, A. J. Stoessl, V. Sossi, **Joint pattern analysis applied to PET DAT and VMAT2 imaging reveals new insights into Parkinson's disease induced presynaptic alterations**, Brain & Brain PET 2019, Yokohama, Japan.

  – **2018**

- I. S. *Klyuzhin*, J.-C. Cheng, C. Bevington, V. Sossi, **Use of a 4D Deep Autoencoder to Denoise Dynamic PET Data**, 2018 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Sydney, Australia, 2018.

- J.-C. Cheng, C. W. J. Bevington, A. Rahmim, I. S. *Klyuzhin*, J. Matthews, R. Boellaard, V. Sossi, **Dynamic PET reconst ruction utilizing a spatiotemporal 4D de-noising kernel**, 2018 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Sydney, Australia, 2018.

- C. W. J. Bevington, J.-C. Cheng, I. S. *Klyuzhin*, V. Sossi, **De-noising and DA release: effect of denoising on the ability to identify voxel level neurophysiological response**, 2018 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Sydney, Australia, 2018.

- M. R. Salmanpour, M. Shamsaee, A. Saberi Manesh, S. Setayeshi, E. Taherinezhad, I. S. *Klyuzhin*, J. Tang, V. Sossi, A. Rahmim, **Machine learning methods for optimal prediction of outcome in Parkinson's disease**, 2018 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Sydney, Australia, 2018.

- K. H. Leung, M. R. Salmanpour, A. S. Manesh, I. S. *Klyuzhin*, V. Sossi, A. K. Jha, M. G. Pomper, Y. Du, A. Rahmim, **Using deep-learning to predict outcome of patients with Parkinson's disease**, 2018 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Sydney, Australia, 2018.

- J. Fu, I. *Klyuzhin*, E. Shahinfard, J. Mckenzie, N. Neilson, T. Baumeise, S. McCormick, J.-C. Cheng, A. Felicio, M. McKeown, A. J. Stoessl, V. Sossi, **Clinical Correlates of Complementary Spatial Patterns in ^{11}C-DTBZ, ^{11}C-MP, ^{11}C-RAC, and ^{11}C-DASB PET Images Revealed by Multiset Canonical Correlation Analysis in Parkinson's Disease**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), London, UK, July 2018.

- I. S. *Klyuzhin*, N. Shenkov, A. Rahmim, V. Sossi, **Use of deep convolutional neural networks to predict Parkinson's disease progression from DaTscan SPECT images**, Society of Nuclear Medicine and Molecular Imaging Annual Meeting, Philadelphia, PA, USA; J. Nucl. Med., vol. 59 (suppl. 1): 29, 2018.

  – **2017**

- I. *Klyuzhin*, N. Vafai, E. Shahinfard, V. Sossi, **The impact of parameter bound selection in the simplified reference tissue method on the accuracy and quality of parametric images**, 2017 Society of Nuclear Medicine and Molecular Imaging Annual Meeting, Denver, CO, USA; J Nucl Med.,vol. 58 (suppl. 1): 359, 2017.

- N. Shenkov, I. *Klyuzhin*, S. Fotouhi, E. Davoodi-Bojd, H. Soltanian-Zadeh, A. Rahmim, V. Sossi, **A metric to quantify DaTSCAN tracer uptake in subjects with Parkinson's disease computed without MRI-based regions of interest**, 2017 Society of Nuclear Medicine and Molecular Imaging Annual Meeting, Denver, CO, USA; J. Nucl. Med., vol. 58 (suppl. 1): 291, 2017.

- I. *Klyuzhin*, J. Fu, N. Shenkov, N. Vafai, E. Shahinfard, J. McKenzie, N. Neilson, K. Dinelle, M. Sacheli, J. Stoessl, A. Rahmim, V. Sossi, **Striatal Neurodegeneration Patterns in Parkinson's Disease Identified using PET Imaging and PCA**, 2017 Organization of Human Brain Mapping Annual Meeting, Vancouver, BC, Canada.

- J. Fu, I. *Klyuzhin*, S. Liu, E. Shahinfard, N. Vafai, N. Heffernan, J. Mckenzie, M. Sacheli, H. F. Wehrl, M. J. McKeown, A. J. Stoessl, V. Sossi, **Altered Serotonergic Network Connectivity in Parkinson's Disease and LRRK2 Mutation Subjects**, 2017 Organization of Human Brain Mapping Annual Meeting, Vancouver, BC, Canada.

- I. *Klyuzhin*, M. Sacheli, N. Vafai, E. Shahinfard, B. Lakhani, J. Neva, J. Fu, J. McKenzie, N. Neilson, K. Dinelle, L. Boyd, A. Stoessl, V. Sossi, **Correlation analysis between dopamine release in striatal sub-regions and motor impairment in Parkinson's disease subjects**, 2017 International Congress of Parkinson's Disease and Movement Disorders, Vancouver, BC, Canada; Mov Disord. 2017; 32 (suppl 2).

- N. Shenkov, I. *Klyuzhin*, A. Rahmim, V. Sossi, **A neuroimaging-based model for disease progression in Parkinson's disease**, 2017 International Congress of Parkinson's Disease and Movement Disorders, Vancouver, BC, Canada; Mov Disord. 2017; 32 (suppl 2).

  – **2016**

- M. A. Sacheli, B. Lakhani, J. L. Neva, D. K. Murray, N. Vafai, J. McKenzie, N. Neilson, K. Dinelle, I. S. *Klyuzhin*, L. A. Boyd, V. Sossi, A. J. Stoessl, **Aerobic exercise can induce dopamine release in Parkinson's disease: [11C]Raclopride PET study**, 2016 Neuroscience Meeting, Program No. 415.28. San Diego, CA: Society for Neuroscience, Nov 14, 2016.

- I. *Klyuzhin*, J. Fu, N. Shenkov, A. Rahmim, V. Sossi, **Sub-regional pattern analysis of heterogeneous PET tracer distribution employed for disease assessment**, 2016 IEEE Nuclear Science Symposium and Medical Imaging (NSS/MIC) Conference Record, Strasbourg, France, Nov 2, 2016.

- J. Fu, N. Vafai, E. Shahinfard, N. M. Neilson, J. Mckenzie, R. Mabrouk, I. *Klyuzhin*, A. J. Stoessl, V. Sossi, **Investigation of Parkinson's Disease Related Covariance Pattern in the Serotonergic System using [11C]-DASB/PET**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), Boston, MA, Jul 15, 2016.

- R. Mabrouk, I. *Klyuzhin*, E. Shahinfard, N. Vafai, J. Fu, S. Blinder, M. Walker, A. Rahmim, V. Sossi, **Exploring feature-based approaches to assess neuroinflammation in patients with Parkinson's disease: a PBR28 PET imaging study**, Proc. Intl. Symp. on Functional Neuroreceptor Mapping of the Living Brain (NRM), Boston, MA, Jul 14, 2016.

- A. Rahmim, Y. Salimpour, S. Jain, S. Blinder, I. *Klyuzhin*, G. Smith, Z. Mari, and V. Sossi, **Application of texture analysis to DaTscan images for enhanced assessment of progression in Parkinson's disease**, Annual Meeting of the Society of Nuclear Medicine and Molecular Imaging (SNMMI), San Diego, CA, Jun 11-15, 2016.

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