RIDC NeuroMat

Project for the period 2018-2024

PI and Center Director: Jefferson Antonio Galves

April 13, 2018

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1.1 Summary of Update

1.2 Young Investigators

The RIDC NeuroMat has systematically developed a program of international attraction of stellar young investigators. Out of fifteen postdoctoral fellows until now within the RIDC NeuroMat, eight of them have been attracted from foreign institutions. They have come from institutions in Argentina, Cuba, France, Greece, Japan, Spain and United States. The RIDC NeuroMat intends to intensify this program of international attraction in the 2018-2024 period with more emphasis on FAPESP's Young Investigators Program. The RIDC NeuroMat also has a specific program of attraction of doctoral candidates from international institutions. Currently, the RIDC NeuroMat has one candidate from France, where he has obtained undergraduate and Master's degrees.

1.3 Additional Funding

The RIDC NeuroMat has systematically received funding from agencies and institutions except FAPESP. For instance, NeuroMat laboratories have been expanded through a grant received by PI Antonio Galves from the University of São Paulo, total value: BRZ R$ 1.6 million. Currently, the RIDC NeuroMat is developing an effort to attract statisticians, engineers, information technology experts, biologists to constitute a start-up to customize and continue the development of the RIDC NeuroMat-developed Neuroscience Experiments System. The RIDC NeuroMat has recently established an agreement with Hospital Universitário of the University of São Paulo to host a new laboratory dedicated to Parkinson's Disease within the RIDC NeuroMat-led AMPARO initiative. The name of the laboratory is Laboratório de Investigação em Cuidado Interprofissional em Doenças Neurodegenerativas - AMPARO. This agreement will enable an important extension of our technology-transfer activities towards Parkinson's Disease patients. The agreement letter, signed by the Hospital Universitário director, Luiz Eugênio Garcez Leme, and the director of USP's Medical School, José Otávio Auler Junior, is available on ANNEX_HU_LETTER. In this agreement, a facility of 150 square meters in the Hospital Universitário is made available to the RIDC NeuroMat. A full list of additional funding sources except FAPESP is available on ANNEX_ADDITIONAL_FUNDING.

1.4 International Advisory Board

The RIDC NeuroMat has been in regular contact and communication with International Advisory Board members. In particular, IAB members have attended RIDC NeuroMat scientific meetings and workshops,

including the meetings in which FAPESP's international evaluation committee visited our laboratory. Our regular contact with the IAB members is described on ANNEX_IAB.

1.5 Governance

The RIDC NeuroMat Principal Investigator is in contact with the Innovation and Dissemination coordinators and managers of the Center at least weekly, normally daily. Meetings of the PI, coordinators and managers take place weekly. RIDC NeuroMat researchers are in touch on a daily basis, with focused meetings in a weekly basis. These regular meetings of investigators are unavoidable, as RIDC NeuroMat Co-Principal investigators lead groups within the Center. The RIDC NeuroMat organizes focused seminars on a weekly basis in each one of its local laboratories, bringing together researchers and students. Also, the RIDC NeuroMat organizes regularly international workshops on topics associated to the RIDC NeuroMat's scientific agenda. Moreover, the RIDC NeuroMat organizes yearly a general meeting of all team members. A full list of meetings, workshops and seminars is available on previous reports that the RIDC NeuroMat has submitted to FAPESP and particularly to the International Evaluation Committee much more than once a year.

1.6 Managers

Management of the RIDC NeuroMat is currently run by three University of São Paulo employees: Lourdes Vaz da Silva Netto, an administrative manager from IME-USP, and her secretary, Vera Lúcia Ribeiro; and an IT analyst, Carlos Ribas, who is a procomptes employee from USP's Pró-Reitoria de Pesquisa. The RIDC NeuroMat had an executive manager, Magda Chang, from 10/26/2015 to 9/26/2017. The management of innovation is currently done by Carlos Ribas. The RIDC NeuroMat PI is currently requesting that this role of management is officially acknowledged by the University of São Paulo. The RIDC NeuroMat PI and area coordinators work on a daily basis with the current management team.

The CV of Carlos Ribas is available on ANNEX_CV_CARLOS_RIBAS. The CV of Lourdes Vaz da Silva Netto is available on ANNEX_CV_LOURDES_NETTO.

1.7 New Staff

The University of São Paulo, in accordance to the agreement that led to the creation of the RIDC NeuroMat, has created a position for an assistant professor at the Department of Statistics of IME-USP, in an area strictly associated to the research agenda of the RIDC NeuroMat, stochastic modeling of neural biological data. The position is held by Aline Duarte de Oliveira, since 1/9/2018.

1.8 Reply and Answers

1.8.1 Fapesp Supervising Panel Evaluation

Fapesp Supervising Panel comment: In the present evaluation, the Committee considered that: "The Center needs to sharpen up their mission and goals. For instance, we have found two definitions as following: a) The mission of NeuroMat is to develop the new mathematics needed to construct a Theory of the Brain accounting for the experimental data gathered by neuroscience research. And also b) The NeuroMat has also the main goal of building the new mathematical framework deemed necessary to address the challenges of neurobiology.

Reply and actions: Both "definitions" are consistent and point to the need to develop new mathematical objects to address the full complexity of neurobiological phenomena.

This calls for the development of a new approach -neuromathematics- conjoining probability theory, statistics, computer science and neurobiology. In this approach, a new class of mathematical models must be introduced to describe and explain in a parsimonious way the different scales of neural activity and their relationship. The construction of these models, however, should marry the simultaneous development of suitable statistical and computational methods, including model selection principles and results.

This is what NeuroMat has been successfully doing in the last five years, and is precisely what we intend to do in the next period 2018-2024.

Fapesp Supervising Panel comment: During their presentation, a couple more specific topics were discussed what helped us to clarify the topics of their science: a) Development of new classes of stochastic processes which are necessary to model brain functioning; and b) Development of the statistical tools required by this new class of stochastic processes. Particularly their tree driven stochastic processes was very interesting. There is a need, however, to determine how all these goals can be put together in a coordinate and concatenated way

Reply and actions: We have tried to put them together in a coordinated and concatenated fashion according to a virtuous cycle. Namely, neurobiological intuitions and questions suggest new mathematical models, which in turn suggest new neurobiological questions, models and experimental protocols. Both require the development of new statistical tools to extract relevant information from the the data collected using these new experimental protocols.

NeuroMat introduced the new mathematical class of *context tree driven stochastic processes* to address neurobiological questions. This class of mathematical models enable us to address from a new perspective the classical conjecture of the Statistician Brain. More precisely, these models suggested a

new experimental protocol to obtain empircial evidences supporting or rejecting the *Statistician Brain* conjecture. To analyse the EEG data collected using the new protocol it was necessary to introduce new statistical tools. The statistical results obtained in this way suggest new neurobiological questions and therefore new experimenetal steps to answer these questions. In turns, the innovative mathematical models being developed inevitably raise new mathematical questions which are valuable also from a purely mathematical point of view. These questions lead to conjectures and proposals for experimental protocols, and the so the cycle continues.

We believe that this virtuous cycle concatenating theoretical and experimental steps is the most promising way to develop the multidisciplinary aspects of a project like NeuroMat.

Fapesp Supervising Panel comment: The center should be able to present clear steps and objectives that would lead it to be considered a top research Center

Reply and actions: There are a number of criteria that shows that we are already considered a top research center by the international community. Our scientific project and our organization scheme joining mathematicians and neuroscientists, is recognized as original and even taken as a model by other research groups.

In all the successive updated versions of our scientific project and scientific reports we made an effort to present in a clear way the guidelines of our work. In our Fourth Report of Activities, presented in 2016, we wrote:

The most general challenge the NeuroMat team faces is the development of new classes of probabilistic models to study different aspects of brain functioning. Aspects of this challenge are at least threefold.

Firstly, it has been necessary to develop a new class of stochastic processes describing nets of spiking neurons. The article Galves and Loecherbach (2013) has been the initial achievement in this direction. Secondly, we are making steps towards a mathematical and statistical framework to formulate the phenomenon of brain plasticity.

Last but not least, we have made efforts to develop stochastic models, statistical procedures and neurobiological experimental protocols to address the classical conjecture of the Statistician Brain. The article Duarte et al. (2016) is a first important step in this direction.

The Fourth Report of Activities summarizes the steps already done by a list of *Main Accomplishments* with seven titles:

1. A new class of models describing systems of spiking neurons

2. Inferring neural interactions

3. Computer simulation of large-scale neural networks

4. Phase transitions, criticality and oscillations in stochastic neuronal networks

5. The statistician brain conjecture

6. Brain plasticity

7. Random graphs and computational psychiatry

This list shows how our approach to neural studies is being developed. These topics are all interrelated and complementary. For instance, the second, third and fourth topics are particular aspects of the first one. The sixth topic involves a notion that is crucial for the statistician brain conjecture (fifth topic) and also is an important ingredient in the description of the neural dynamics which is the content of the first topic.

To answer the committee's request concerning our next steps, we present below a list of ongoing projects. In our opinion, many of these projects have the potencial to trigger important changes in the state-of-the-art of neuromathematics and lead to innovative protocols in neurobiology.
Ongoing projects

1. Hebbian time evolution for the interaction graph of a network of spiking neurons

2. Statistical analysis of stochastic processes

3. Neuroscience experimental data management

4. Structural learning and decision making

5. Modeling the plasticity in the brain after a traumatic brachial plexus injury in adults

6. Stochastic modeling spatio-temporal patterns of epileptic seizures

7. Random networks for the brain

During our almost five years of existence many reports summarizing our results were produced following the guidelines of our founding scientific projects.

1.9 Foreseen Actions

1.9.1 Innovation and Technology Transfer

NeuroMat's technology transfer mission is to develop innovative tools and applications based on theoretical and conceptual developments obtained by our research team.

The plan of innovation and technology transfer activities for the 2018-2024 period includes three main fronts:

- Tools to measure brain plasticity;
- Diagnostic and prognostic tools for neurological diseases and disorders;
- Computational tools for data support and management in neuroscience.

1.9.1.1 Tools to measure brain plasticity One of NeuroMat's scientific objectives is to develop mathematical tools to assess and model plastic alterations in cortical circuits following peripheral nerve injury. To achieve this goal, new technological tools are necessary to accurately map the dynamic changes of cortical nerve and muscle representations. Transcranial magnetic stimulation (TMS) has recently emerged as an important brain mapping technique and the team led by Claudia Vargas at UFRJ will use TMS to measure peripheral nerve maps in primary motor cortices of healthy subjects and their plastic changes in people with traumatic brachial plexus injury (TBPI).

The objective of this technology transfer front is to develop a closed-loop robotic arm that can deliver transcranial magnetic stimulation to specific areas of the brain with higher precision and reproducibility than it is possible today. The project will be coordinated by Oswaldo Baffa and his group (Biomag group) at USP Ribeirão Preto. A neuronavigation software, under development by Biomag lab graduate students, will be used to guarantee the precision of TMS delivery and the robotic arm will assure the reproducibility and real-time position correction of TMS pulse delivery. The challenge will be to control the robotic arm with the neuronavigation software in an autonomous mode. This last aspect is an area of intense research in several experimental neuroscience groups around the world and could have many spin offs to other applications.

Also planned is the development of a multi-locus TMS (mTMS) device. This cutting edge technology allows to change the stimulation site in a defined cortical area by means of electronic control, i.e. without manual movement of the stimulation transducer. The mTMS allows a fast, accurate mapping of motor areas, and the study of short-interval intracortical mechanisms that were not possible before due to methodological limitations. This device will be constructed by the Biomag lab in collaboration with the group of Risto Ilmoniemi in Aalto University in Finland.

1.9.1.2 Diagnostic and prognostic tools for neurological diseases and disorders NeuroMat's initiatives in this front will focus on three clinical applications:

- Parkinson's disease;
- Brachial plexus injury;

- Psychosis and psychiatric disorders.

1.9.1.3 Parkinson's disease There is no known cure for Parkinson's disease (PD) and current medical treatment only provides symptomatic benefits. Clinical PD diagnosis is based on the onset of motor symptoms, specifically bradykinesia, but the neurodegenerative process starts years before the display of these symptoms. Early PD diagnosis would provide a window of opportunity in which potential drugs and neuroprotective agents could be investigated in search for more successful treatments. The physiopathology of bradykinesia is not fully known but the decline in the autonomic motor control, mainly in the gait, has been associated to this symptom. Recent evidence suggest that gait control under dual-task conditions, i.e. in which a cognitive task is performed concurrently with walking, could be a promising way for early PD diagnosis.

Although the dual-task experimental protocol has often been used for PD assessment, not enough attention has been given to the different types of behavior that persons with PD exhibit in this protocol. For example, persons with PD can either priorize the motor or the cognitive task. Current literature focuses only on an unidimensional scale of performance and not on the many types of behavior that can occur. Such an unidimensional scale does not capture many important features on how much the disease impacts on the person's daily life.

The NeuroMat team composed by Antonio Roque (USP), Marco Gubitoso (USP), Maria Elisa Piemonte (USP and Associação Brasil-Parkinson) and Rafael Stern (UFSCar) will take into account a longitudinal study with healthy individuals and PD patients to define clustering criteria for the diverse types of behavior observed in dual task protocols. The study will be done in a new NeuroMat laboratory at USP's University Hospital (Hospital Universitário da USP, HU-USP), which will be coordinated by Maria Elisa Piemonte. The goal is to obtain a classifier for the different types of behavior, which would lead to a better diagnosis and suggestions of treatment improving the patient's quality of life.

Besides traditional cognitive tasks, the NeuroMat team will also use the Goalkeeper Game (see below) as a tool for PD clinical assessment. Preliminary evidence in persons with PD from Associação Brasil-Parkinson suggest that the Goalkeeper Game is at least as effective as the Montreal Cognitive Assessment (MoCA) test to predict decline in cognitive performance observed in everyday life. The objective will be to develop a new free and friendly test for early diagnosis of PD by e.g. cell phones using the Goalkeeper Game.

1.9.1.4 Brachial plexus injury The group led by Kelly Braghetto (USP) will develop a system for prognosis of traumatic brachial plexus injuries in adults based on random forest models. The prognostic model will be generated from a set of clinical and sociodemographic data of INDC-UFRJ patients diagnosed with neurological brachial plexus injury. This study also aims to identify the predictors of the

response of patients to the rehabilitation treatment. The innovative aspect of this work is that there is no prognostic model for this type of injury.

1.9.1.5 Psychosis and psychiatric disorders This front will be coordinated by Sidarta Ribeiro (UFRN). The objective is to use graph-theoretical tools to describe and quantify the structure of the flow of thoughts, as expressed on verbal accounts, to help diagnosis of persons with psychiatric disordes. This representation has been successfully applied to describe the typical speech structures of persons with schizophrenia and bipolar mood disorder. The goal for the next period is to apply this approach to map the cognitive decline that follows the first psychotic episode, still in the adolescence, in order to establish the early symptoms that allow for an early intervention.

1.9.1.6 Computational tools for data support and management in neuroscience NeuroMat's initiatives on computational tools are aimed at the development of free and open source software tools. The software tools under current development are:

- Goalkeeper Game;
- Neuroscience experiments system (NES);
- NeuroMat Open Database.

1.9.1.7 Goalkeeper game An innovation spin-off from our research involving sequences of stimuli represented by context trees is the "Goalkeeper Game". It is a videogame with desktop and mobile device versions (the latter under development) in which the player, taking the role of a goalkeeper in a penalty shootout, guesses the position in the goal where the ball will hit (left side, right side or center) after being kicked by the opponent. The game consists in a sequence of penalty kicks in which the ball positions are generated by a random context tree. As the player (the goalkeeper) succeeds in guessing the right sequence the complexity of the tree increases and the game becomes more difficult.

The Goalkeeper Game has potential to be used as diagnosis and rehabilitation tool in neurology, and the NeuroMat technology transfer team is currently testing its applicability in our two main clinical fronts: Parkinson's disease and brachial plexus injury.

1.9.1.8 Neuroscience experiments system (NES) The Neuroscience Experiments System - NES (github.com/neuromat/nes) is a free software developed by NeuroMat to manage data and metadata from neuroscience experiments. It integrates data records from different types such as clinical, electrophysiological, and behavioral, while keeping together experimental data and its fundamental provenance

information, such as detailed descriptions of experiments (including, e.g., purposes, data collecting protocols, experimental conditions, subjects data, and responsible researchers). With this, NES provides a structured and comprehensive platform with a robust tracking of data provenance that is fundamental to enable the reproduction of neuroscience experiments and to support data analysis.

NES has been used to manage the experimental data collected in the NeuroMat's AMPARO and ABRAÇO initiatives, and will be used in the same fashion by the new experimental teams added to NeuroMat for the next period of activities. New additions to NES planned to be done in the next period include a neuroimaging module, a platform for the design and execution of computational data processing and analysis, and the integration of the software InVesalius Navigator and Signal Hunter developed by the Biomag group in Ribeirão Preto.

1.9.1.9 NeuroMat Open Database The NeuroMat Open Database (http://neuromatdb.numec.prp.usp.br/) provides an open-access platform for sharing and searching data and metadata from neuroscience experiments. The platform is constituted by a web portal and a REST (Representational State Transfer) API (Application Programming Interface). The web portal is being designed to have an an user-friendly interface for database access by the neuroscience community. The REST API is used to feed the open database with experimental data generated by NeuroMat's researchers. Currently, the API intermediates the receiving and retrieving of data from research laboratories which use NES (Section 1.9.1.8), but the API can easily be adapted to receive (or transfer) data from (for) other client systems.

1.9.2 NeuroMat science dissemination mission and objectives

1.9.2.1 Mission As indicated on the NeuroMat project, neuroscience is expected to lead, in the near future, to radical changes in the way humankind conceives learning, aging, mental disorders, healing from neurological trauma, mind-machine interfaces and other foundational neural issues. These changes depend, inter alia, on the building of new conceptual frameworks based on mathematical approaches and open discussions and interchange of information among scientists. A research enterprise of such an ambitious scope crucially requires public awareness, both to justify the necessary support in resources and to attract young researchers to enrich and perpetuate the flow of ideas. It is, therefore, important to bridge the gap between scientific production and knowledge dissemination.

1.9.2.2 Objectives FAPESP's RIDC NeuroMat has worked along three interconnected objectives in science dissemination of topics pertaining to Neuromathematics:

1. intensive, crossmedia communication, particularly through the NeuroMat Wikipedia Initiative;

2. interdisciplinary training programs, workshops and events on Neuromathematics and pertaining topics to specialized and general audiences; and

3. research on the science of communicating science as a necessary step to reflect on and improve NeuroMat's science dissemination initiatives.

1.9.2.3 FAPESP's Supervising Panel Evaluation on NeuroMat's dissemination activities

FAPESP's assessment NeuroMat's science dissemination work in the context of FAPESP's Supervising Panel Evaluation, based on the assessment mission of the International Committee, was broadly characterized as:

- "[an] excellent performance" (General Evaluation Form, p. 3)
- "an impressive dissemination of knowledge on the international web" (General Evaluation Form, p. 4)
- "Excellent" (Reviewer 1 Form, p. 4)
- "Excellence in the fields of knowledge transfer and dissemination" (Reviewer 2 Form, p. 2)
- "a very good job" (Reviewer 3 Form, p. 3)

More specifically in the evaluation highlighted that:

- "the NeuroMat's Wikipedia Initiative has reached over 14 million internet users globally" (General Evaluation Form, p. 3)
- "I particularly like they NeuroMat Wikipedia activity and I strongly recommend it" (Reviewer 1 Form, p. 4)
- "very good set of conferences and workshops" (Reviewer 1 Form, p. 4)
- "a well conceived association with some University of São Paulo Museums" (Reviewer 2 Form, p. 24)

NeuroMat's general response to FAPESP's assessment From FAPESP's Supervising Panel Evaluation, NeuroMat's science dissemination team understands that the general perspective is to pursue work along the lines that were described and listed on the annual and complementary reports (available at http://neuromat.numec.prp.usp.br/reports). The NeuroMat Wikipedia Initiative was pinpointed as a specific line of work to be invested on.

NeuroMat's Wikipedia Initiative has indeed become a strategic activity at the interface of communication, exhibition and education. It has been recognized in Brazilian and foreign outlets as "success case" of the use of Wikipedia and other collaborative projects as a means of scientific dissemination. This has led the RIDC NeuroMat, and its main supporting agency, FAPESP, to be described as key institutional players in the realm of this type of dissemination strategy.

1.9.2.4 NeuroMat's dissemination achievements

NeuroMat Wikipedia Initative Metrics associated to the NeuroMat Wikipedia Initiative from 2013 to March 2018 include, according to official program metrics (DISSEMINATION_ANNEX_01_WIKIPEDIA):

- 15 specific education and outreach programs;
- 199 editors involved, including students and researchers;
- 4,36 million words added to Wikipedia in Portuguese;
- 7,650 entries improved and 1,960 entries created on Wikipedia in Portuguese;
- 13 entries on Mathematics chosen as featured articles, that is, among the best content on Wikipedia in Portuguese; and
- 16,2 million views of articles created and improved by the RIDC team.

A key aspect of the NeuroMat Wikipedia Initiative has been media production, which have resulted, according to official program metrics (DISSEMINATION_ANNEX_02_UPLOADS), in:

- 1,709 pictures uploaded;
- 11 movies uploaded;
- 144 audio files uploaded; and
- 103 million content views since 2013.

Institutional partnerships in the context of the NeuroMat Wikipedia Initiative The NeuroMat Wikipedia Initiative has been an opportunity for establishing institutional partnerships with:

- the RIDC BRAINN (for an education program on Basic Physics)
- the RIDC NEV (for a workshop on wiki-dissemination)

- the University of São Paulo Museu Paulista for the systematic upload of its collection onto Wikimedia projects;
- the University of São Paulo Museum of Mathematics ("Matemateca") for the systematic upload of its collection onto Wikimedia projects;
- the University of São Paulo Museum of Veterinary Anatomy for the systematic upload of its collection onto Wikimedia projects;
- the Wikimedia Community User Group Brasil.

Key dissemination initiatives Key dissemination initiatives from NeuroMat's science dissemination team include:

- NeuroMat website (details and impact available on DISSEMINATION_ANNEX_03_WEBSITE)
- NeuroMat Facebook page (details and impact available on DISSEMINATION_ANNEX_04_FACEBOOK)
- NeuroMat Newsletter (details and impact available on DISSEMINATION_ANNEX_05_NEWSLETTER)
- Media coverage (details and impact available on DISSEMINATION_ANNEX_06_MEDIA_COVERAGE)
- NeuroMat's Blog Traço de Ciência (details and impact available on DISSEMINATION_ANNEX_07_BLOG_VIEW and DISSEMINATION_ANNEX_08_BLOG_POSTS)
- AMPARO dissemination resources (details and impact available on DISSEMINATION_ANNEX_09_AMPARO_W and DISSEMINATION_ANNEX_10_AMPARO_ACTIVITIES)
- ABRAÇO dissemination resources (details and impact available on DISSEMINATION_ANNEX_11_ABRACO_W and DISSEMINATION_ANNEX_12_ABRACO_RESOURCES)

Conferences, training workshops and other events The dissemination activities that the NeuroMat team has sustained have sparked or been sparked by regular conferences, training workshops and other events that NeuroMat has organized or supported:

- Conferences (DISSEMINATION_ANNEX_13_CONFERENCES)
- Training workshops (details on DISSEMINATION_ANNEX_14_TRAINING_WORKSHOPS)
- Other events (details on DISSEMINATION_ANNEX_15_OTHER_EVENTS)

Research on the science of communication science The set of dissemination activities that the NeuroMat team has led has informed research projects on the science of communicating science. These projects have resulted as of March 2018 in:

- Giulia Modupe Ebohon, Fernando J. da Paixão and João Alexandre Peschanski, "Crise da imagem na difusão científica: apontamentos a partir da teoria de Josep M. Català" (under review)
- Daniel Dieb, Fernando J. da Paixão and João Alexandre Peschanski, "O uso da Wikiversidade no ensino do jornalismo científico: abertura, colaboração e conectivismo" (under review)
- Daniel Dieb and João Alexandre Peschanski, "Jornalismo Científico: Prática e Revisão de Literatura", Divisão Temática de Jornalismo, da Intercom Júnior – XIII Jornada de Iniciação Científica em Comunicação, evento componente do XL Congresso Brasileiro de Ciências da Comunicação, September, 2017.
- Giulia Ebohon and João Alexandre Peschanski, "Neuromatemática Representada: A imagem na difusão científica", GP Comunicação, Imagem e Imaginários, XVII Encontro dos Grupos de Pesquisas em Comunicação, evento componente do 40º Congresso Brasileiro de Ciências da Comunicação, September, 2017.
- João Alexandre Peschanski, "A Wikipédia e o poder", COMPÓS 2017, June 7, 2017.
- Célio Costa Filho, "Iniciativas GLAM - museus para download", 4º Encontro de Divulgação de Ciência e Cultura, UNICAMP, April 4, 2017.
- João Alexandre Peschanski and Marília Reinato Carrera, "Wikipédia e Educação: Projeto de Pesquisa 'Matemática Falada: Audiodescrição de Verbetes de Probabilidade e Estatística na Wikipédia'", IV Fórum de Discussão – Parâmetros Balizadores da Pesquisa em Educação Matemática, April, 2017.
- David Fernando Levon Alves, João Alexandre Peschanski and Jean Carlos Ferreira dos Santos, "Tecnologias colaborativas na difusão científica: um relato dos usos e apropriações da Wikipedia no Cepid Neuromat", IX Simpósio nacional da Associação Brasileira de Pesquisadores em Cibercultura, December, 2016.
- João Alexandre Peschanski, "Wikipédia contra a ignorância racional", GP Comunicação e Educação do XVI Encontro dos Grupos de Pesquisa em Comunicação, evento componente do XXXIX Congresso Brasileiro de Ciências da Comunicação, September, 2016.
- Fernando da Paixão, João Alexandre Peschanski, Célio Costa Filho and David Alves, "O uso da Wikipédia na difusão científica", Divisão Temática Interfaces Comunicacionais, da Intercom

Júnior – XII Jornada de Iniciação Científica em Comunicação, evento componente do XXXIX Congresso Brasileiro de Ciências da Comunicação, September, 2016.

- João Alexandre Peschanski, "Ernesto Hamburger 2.0: a experiência de difusão científica colaborativa do NeuroMat", na mesa-redonda "Desafios da difusão científica: homenagem a Ernesto Hamburger", at Universidade de São Paulo, in June, 2016. Published at "Pensar a educação em pauta", UFMG, ano 4, n. 129, July 8, 2016.

- João Alexandre Peschanski, Renato Moraes, Mariana Diello and Marília Carrera, "A wiki-pedagogia no Jornalismo", Revista Brasileira de Ensino de Jornalismo, v. 6, n. 18, p. 75-100, jan./jun. 2016.

Course for science journalists The NeuroMat science dissemination team has been developing an online, open course on science journalism on the web platform Wikiversidade. The course is set up as a MOOC and is directed to graduate students and professionals. This course strictly meets the request of FAPESP's Programa José Reis de Incentivo ao Jornalismo Científico, which states: "a specific objective [of this program] is to stimulate the creation of science-journalism courses, inside and outside academia, with the possible support of communications company."

The course is available at: https://pt.wikiversity.org/wiki/Introdução_ao_Jornalismo_Científico

External support NeuroMat's science dissemination activities have been supported mostly by FAPESP but also:

- Wikimedia Foundation (in support to activities with Wikimedia in Brazil): US$ 21,800

- Interdisciplinary Research Center (research grant): US$ 14,000

1.9.2.5 NeuroMat science dissemination renewal proposal This section presents NeuroMat's renewal proposal for the area of science dissemination in accordance to instructions provided by FAPESP. This section is built in strictly reliance to NeuroMat's science-dissemination mission and objectives, FAPESP's Supervising Panel Evaluation on NeuroMat's dissemination activities and NeuroMat's dissemination achievements as reported here and in the annual and complementary forms previously submitted to FAPESP.

Proposal rationale The original NeuroMat project the section pertaining to science dissemination listed the following programs: Interdisciplinary Workshops; Courses for public secondary school teachers; Extension to medical and ancillary staff; Web portal; and Exhibitions. The program goals have been

strictly met, unless in circumstances in which there has been a general understanding that fundamental changes were necessary. This understanding, when it has occurred, was systematically reported to FAPESP.

The main change is that at the time of the proposal the NeuroMat science dissemination team had not envisioned the NeuroMat Wikipedia Initiative, which has become the leading program of the RIDC science dissemination team. This initiative encompasses to some extent all dimensions of the goals and objectives that have informed the inception of the NeuroMat science dissemination team –and has been described as a "2.0 version" of the original NeuroMat science dissemination proposal.

Since 2014, NeuroMat has led an initiative to improve scientific content on Wikimedia projects, especially Wikipedia in Portuguese. This initiative was framed as "a call to duty," to the extent that it recognized that this electronic encyclopedia, one the ten most visited websites in the world, is a go-to reference for educational purposes. The conjecture that this initiative relies on is: It is plausible that levels of scientific culture have an impact on the quality of contributions to scientific entries on Wikipedias of all languages; yet, what is the expected impact of the quality of Wikipedia scientific entries, as an open educational resource, to the level of scientific culture.

The conjecture that one could rely on Wikimedia projects to improve scientific culture has been a general perspective for a sequence of initiatives on these projects by the RIDC NeuroMat, especially Wikipedia in Portuguese. These initiatives have been associated to graduate and undergraduate students, coordinated by professors and researchers from the RIDC, and have relied on formal partnerships, for instance, with the User Group Wikimedia in Brazil and University of São Paulo museums.

Given this context and especially the last FAPESP assessment, the RIDC team understands that the compass point of our dissemination team, both in terms of savoir-faire and expected impact on the Brazilian scientific culture, ought to be digital science dissemination, particularly collaborative projects like Wikipedia. This is the rationale of this renewal proposal.

Programs In general terms, the NeuroMat science dissemination plan of action for the renewal periods will include:

- the development of the NeuroMat Wikipedia Initiative;
- the offering of training for science popularizers, researchers, students and the general public on web-2.0 science dissemination and other pertaining areas for the general goal of the RIDC NeuroMat;
- the systematic production of research on science dissemination, thus providing resources and establishing a network for moving forward the theory and practice of science communication;

- the systematic production of pictures and videos, normally licensed under an open, free license, as to stimulate sharing and remixing;
- the offering of MOOC-like courses on topics associated to the work of NeuroMat teams;
- the establishment of partnerships to foster a digital science-communication network, particularly connected to collaborative initiatives;
- the organization and support of conferences, training sections and other events, including activities in public schools; and
- the possible launching of a FAPESP-wide or at least RIDCs-wide campaign for the the use of Wikimedia projects in science dissemination.

2 NeuroMat team 2018-2024

The RIDC NeuroMat Principal Investigator and Center Director remains Jefferson Antonio Galves.

The International Advisory Board has two new members, Markus Diesmann (Institute of Neuroscience and Medicine – Juelich) and Francesco Guerra (Università di Roma “La Sapienza”). They have joined the Board along with David Brillinger (University of California, Berkeley), Leonardo Cohen (National Institute of Neurological Disorders and Stroke) and Wojciech Szpankowski (Purdue University, current director of the NSF Science and Technology Center for Science of Information).

The Co-Principal Investigators team has one new member, Oswaldo Baffa Filho (Universidade de São Paulo). He has joined the Co-Principal Investigators Team along with Pablo Augusto Ferrari (Universidade de São Paulo and Universidad de Buenos Aires), Fernando Jorge da Paixão Filho (Universidade Estadual de Campinas), Antonio Carlos Roque da Silva Filho (Universidade de São Paulo), Jorge Stolfi (Universidade Estadual de Campinas), Claudia Domingues Vargas (Universidade Federal do Rio de Janeiro).

The Distinguished Associate Investigators Team (outside São Paulo) has a new member, Etienne Koechlin (Ecole Normale Supérieure de Paris). He has joined the Distinguished Associate Investigators Team (outside São Paulo) along with Marzio Cassandro (Università di Roma “La Sapienza"), Pierre Collet (CNRS - Ecole Polytechnique), Roberto Fernandez (NYU Shangai), Ricardo Fraiman (Universidad de la Republica, Uruguay), Eva Loecherbach (Université de Paris Seine), Christophe Pouzat (Universitè Paris Descartes), Errico Presutti (Gran Sasso Science Institute (L’Aquila)), Patricia Reynaud-Bouret (CNRS- Université de Nice Sophia-Antipolis), Sidarta Ribeiro (Universidade Federal do Rio Grande do Norte).

A full list of RIDC NeuroMat team members is available on ANNEX_TEAM_2018-2024.

3 NeuroMat fellowships

3.1 Postdoc

We intend to have in permanence seven postdoctoral researchers working within the research framework of the RIDC NeuroMat. This research framework is strictly related to the original research agenda that was presented to FAPESP including eventual revisions systematically reported to FAPESP in yearly reports of activities. The forthcoming fellowships will pursue work that is already ongoing within the RIDC NeuroMat; specific details of these projects can be found in ANNEX_FELLOWSHIPS_01_POSTDOCS

3.2 TT5

The RIDC NeuroMat has had up to now only three TT5 positions per year. This was barely enough considering our intense activities in technology transfer. We request five TT5 positions per year in order to account for the increasing level of activities in technology transfer within the RIDC NeuroMat. Specific details of these positions can be found in ANNEX_FELLOWSHIPS_02_TT5

3.3 BJC

We intend to pursue activities in science dissemination with eight year-long Science Journalism Fellows per year in the 2018-2024 period. Lines of activity include: The uses of Wikimedia projects inside scientific dissemination; Complex image and the visual representation of the sciences and practices of Neuromathematics; Production and curation of media in museology and exhibition construction; Communication and initiatives of transfer in health; and Journalism education and scientific endojournalism in the frontier of science. Details on each program agenda associated to science journalism research and project appointments are available on APPOINTMENTS_ANNEX_03_SCIENCE_JOURNALISM.

4 Annexes

- Section 1
  - ANNEX_HU_LETTER
  - ANNEX_ADDITIONAL_FUNDING
  - ANNEX_IAB
  - ANNEX_CV_CARLOS_RIBAS
  - ANNEX_CV_LOURDES_NETTO
- Section 1.9
  - DISSEMINATION_ANNEX_01_WIKIPEDIA
  - DISSEMINATION_ANNEX_02_UPLOADS
  - DISSEMINATION_ANNEX_03_WEBSITE
  - DISSEMINATION_ANNEX_04_FACEBOOK
  - DISSEMINATION_ANNEX_05_NEWSLETTER
  - DISSEMINATION_ANNEX_06_MEDIA_COVERAGE
  - DISSEMINATION_ANNEX_07_BLOG_VIEWS
  - DISSEMINATION_ANNEX_08_BLOG_POSTS
  - DISSEMINATION_ANNEX_09_AMPARO_WEBSITE
  - DISSEMINATION_ANNEX_10_AMPARO_ACTIVITIES
  - DISSEMINATION_ANNEX_11_ABRACO_WEBSITE
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  - DISSEMINATION_ANNEX_13_CONFERENCES
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  - DISSEMINATION_ANNEX_15_OTHER_EVENTS
- Section 2
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- ANNEX_FELLOWSHIPS_01_POSTDOCS
- ANNEX_FELLOWSHIPS_02_TT5
- APPOINTMENTS_ANNEX_03_SCIENCE_JOURNALISM