

## Curriculum Vitae

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**Place of Birth:** Taipei City, Taiwan

### Education

2002	MD	School of Medicine	National Yang Ming University, Taipei, Taiwan
2011	PhD	Institute of Clinical Medicine (PhD Advisor: Prof. <b>Norden E. Huang</b> )	National Yang Ming University, Taipei, Taiwan

### Postdoctoral Training

10/01-06/02	Internship	Medicine & Surgery	Taipei Veterans General Hospital, Taipei, Taiwan
06/01	Clerkship	Cardiology	Department of Cardiology, Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, Massachusetts, USA
07/01	Clerkship (Sponsored by American Bureau for Medical Aid to China)	Radiology	Presbyterian Hospital, New York City, New York, USA
09/02-07/04	Research Fellow	Nonlinear Dynamics in Medicine	Margret and H. A. Rey Institute for Nonlinear Dynamics in Medicine, Beth Israel Deaconess Medical Center/Harvard Medical School, Boston, Massachusetts, USA

08/04-07/05	Resident	Psychiatry	Department of Psychiatry, Jianan Mental Hospital, Tainan, Taiwan
08/05-07/08	Resident	Psychiatry	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan
08/08-07/09	Chief Resident	Psychiatry	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan
07/13-06/14	Fellowship	Sleep	Department of Pulmonary, Critical Care and Sleep Medicine, Beth Israel Deaconess Medical Center, Boston, USA

### Faculty Academic Appointments

08/09-01/12	Lecturer	Psychiatry	School of Medicine, National Yang-Ming University, Taipei, Taiwan
08/11-07/12	Lecturer	Biomedical Research	Center for Dynamical Biomarkers and Translational Medicine, National Central University, Chungli, Taiwan
02/12-07/16	Assistant Professor	Psychiatry	School of Medicine, National Yang-Ming University, Taipei, Taiwan
08/12-11/16	Assistant Professor	Biomedical Research	Center for Dynamical Biomarkers and Translational Medicine, National Central University, Chungli, Taiwan
07/13-06/15	Visiting Assistant Professor	Medicine	Harvard Medical School, Boston, USA
08/16-07/17	Associate Professor	Psychiatry	School of Medicine, National Yang-Ming University, Taipei, Taiwan
<b>08/16- Present</b>	<b>Adjunct Associate Professor</b>	<b>Institute of Brain Science</b>	<b>School of Medicine, National Yang-Ming University, Taipei, Taiwan</b>
<b>12/16- Present</b>	<b>Instructor (ladder track)</b>	<b>Medicine</b>	<b>Harvard Medical School, Boston, USA</b>

### Appointments at Hospitals/Affiliated Institutions

07/09	Attending Physician	Psychiatry	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan
08/09-09/11	Attending Physician	Psychiatry	Chu-Tung Veterans Hospital, Hsin-Chu County, Taiwan
10/11-11/16	Attending Physician	Psychiatry	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan
<b>12/16- Present</b>	<b>Research Faculty</b>	<b>Interdisciplinary Medicine and Biotechnology</b>	<b>Beth Israel Deaconess Medical Center, Boston, USA</b>

### Other Professional Positions

2011- Present	Fellow	International Society for Affective Disorders
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### Major Administrative Leadership Positions

#### Local

<b>2012- Present</b>	<b>Principal Investigator</b>	<b>Laboratory of Precision Psychiatry (formally Laboratory of Nonlinear Dynamics in Psychiatry)</b>
2012-2016	Director, Sleep Lab in Department of Psychiatry	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan
2013-2016	Deputy Executive Officer, Sleep Medicine Center	Taipei Veterans General Hospital

#### Regional

N/A

#### National and International

N/A

### Committee Service

#### Local

N/A

#### Regional

N/A

#### National and International

N/A

### Professional Societies

2005- Present	Member	Taiwanese Society of Psychiatry
2009- Present	Member	Taiwanese Society of Geriatric Psychiatry
2010- Present	Member	Taiwan Dementia Society
2011- Present	Member	Taiwan Society of Sleep Medicine
2012- Present	Member	World Suicidology Net
2012- Present	Member (#281224)	American Academy of Sleep Medicine

### Grant Review Activities

2012- Present	Ad hoc Member	Taipei Veterans General Hospital, Taipei, Taiwan
2016	Ad hoc Reviewer	Medical Research Council, UK

### Editorial Activities

#### **Ad Hoc Reviewer**

Archives of Suicide Research  
Asia Pacific Psychiatry  
JAMA Psychiatry (Archives of General Psychiatry)  
Biological Psychology  
Biomedical Engineering OnLine  
Briefings in Bioinformatics  
BMC Medical Genomics  
BMC Neurology  
BMC Psychiatry  
Brain, Behavior and Immunity  
Brain Imaging and Behavior  
Brain Research Bulletin  
Cephalalgia  
Chronobiology International  
Clinical EEG and Neuroscience  
Clinical Neurology and Neurosurgery  
Clinical Neurophysiology  
Computers in Biology and Medicine  
Critical Care Medicine  
Current Psychiatry Reviews  
European Archives of Psychiatry and Clinical Neuroscience  
Frontiers Neuroscience  
Human Brain Mapping  
IEEE Trans Medical Imaging

International Journal of Environmental Research and Public Health  
 Journal of Affective disorders  
 Journal of Alternative and Complementary Medicine  
 Journal of Autism and Developmental Disorders  
 Journal of Neuroscience Methods  
 Journal of the Chinese Medical Association  
 Literary and Linguistic Computing  
 Nature Digital Medicine  
 Neurobiology of Aging  
 Neuroimage  
 Neuroimage: Clinical  
 Philosophical Transactions A  
 Physiology and Behavior  
 Progress in Neuro-Psychopharmacology & Biological Psychiatry  
 PLoS One  
 Psychiatry Research  
 Psychiatry Research – Neuroimaging  
 Psychopathology  
 Psychopharmacology  
 Psychophysiology  
 SciTechnol  
 Science of the Total Environment  
 Schizophrenia Research  
 Tohoku Journal of Experimental Medicine  
 Toxics

### **Other Editorial Roles**

2012-2016	Editorial Board	International Scholarly Research Network (ISRN) Geriatrics
2012-2013	Co-guest Editor Special issue: “Complexity of Mental Illness”	Progress in Neuro-Psychopharmacology & Biological Psychiatry
2014-2017	Editorial Board	Neuropsychiatric Electrophysiology
2017-2018	Guest Editor Special Issue: Multi-scale Brain Complexity	Frontier Neuroscience
<b>2018-Present</b>	<b>Editorial Board</b>	<b>Nature Digital Medicine</b>

### **Honors and Prizes**

1999	First-Prize Award	Summer Research Program of Taipei Veterans General Hospital, Taiwan	Research
2000	First-Prize Award	Schering-Plough Students’ Research Program / American Bureau for Medical Aid to China	Research

2002	Winner of Event 2 Contest	PhysioNet/Computers in Cardiology Challenge, USA	Research
2003	The Calvin & Rose G Hoffman Marlowe Memorial Trust Prize, UK	The Calvin & Rose G Hoffman Marlowe Memorial Trust	Literary Research
2011	Lifu Medical Research Foundation Award	Lifu Medical Research Foundation	Dementia Research
2011	Dr. Tsai Memorial Award	Taiwanese Society of Psychiatry	Psychiatry
2012	Travel Award	20 <sup>th</sup> European Congress of Psychiatry	Psychiatry
2013	Young Scientist Award	11 <sup>th</sup> World Congress of Biological Psychiatry	Psychiatry
2013	Best Poster Award	11 <sup>th</sup> World Congress of Biological Psychiatry	Psychiatry/Sleep

## **Report of Funded and Unfunded Projects**

### **Funding Information**

#### **Past**

2012	Dynamical Biomarkers of Aging Based on Analysis of Spontaneous Brain Activity Using Resting State Fmri Taipei Veterans General Hospital and University System (VGHUST100-G1-4-1) Co-PI We anticipate to develop an array of dynamical biomarkers based on complexity analysis of BOLD time series to quantify the normal aging and declined cognitive function in dementia subjects.
2012	Dynamical Biomarkers of Slow Wave Sleep During Sleep Based on Analysis of Spontaneous Brain Activity Using Resting State fMRI Taipei Veterans General Hospital and University System (VGHUST100-G1-4-2) Co-PI We anticipate to develop an array of dynamical biomarkers based on complexity analysis of BOLD time series to quantify the normal and poor sleep.
2012	Development of Dynamical Biomarkers of Spontaneous Brain Activity Taipei Veterans General Hospital and University System (VGHUST100-G1-4-3) Co-PI We expect to develop and refine an array of dynamical biomarkers for quantifying aging and illness, and to establish a mathematical model describing the behavior of spontaneous BOLD activity under normal and pathological conditions.
2013	Development of Physiologic Biomarkers for Differentiating Subtypes of Major Depression Taipei Veterans General Hospital and University System (VGHUST102-G1-2-2) PI

The major goal of the project is to developing physiologic biomarkers based on whole-night polysomnography to differentiate the subtypes of MDD patients.

- 2013 Delineating the Temporal and Spatial Relationship Between Suicide Death and Suicide News  
Taipei Veterans General Hospital (V102B-015)  
PI  
The study is to understand the link between suicide news and suicide death in the temporal and spatial dimension and to understand if there is cumulative effect on the copycat suicide even in the non-celebrity suicide news report.
- 2013 Development of Neuroimaging Biomarkers for Differentiating Subtypes of Major Depression  
Taipei Veterans General Hospital and University System (VGHUST102-G1-2-1)  
Co-PI  
We anticipate to develop the neuroimaging biomarkers based on complexity analysis of BOLD time series to quantify the subtypes of major depressive disorder.
- 2013 Understanding the Link Between Functional Brain Activity and Psychophysiology  
Taipei Veterans General Hospital and University System (VGHUST102-G1-2-3)  
Co-PI  
We expect to identify brain regions that their activity are correlated with physiologic time series and use these information to delineate the pathophysiology involved in different subtypes of MDD patients.
- 2014 Complexity Analysis of EEG Signals in Patients with Primary Insomnia  
Taipei Veterans General Hospital (V103B-012)  
PI  
We aim to use assess the dynamical complexity of EEG in patients with primary insomnia and develop markers for differentiating patients with insomnia and healthy subjects.
- 2012-2015 The effect of psychosis susceptibility gene polymorphism on functional and structural brain network in schizophrenia  
National Science Council (NSC 101-2314-B-075-041-MY3)  
PI  
The major goal of the study is to identify the abnormality of brain network property of schizophrenia and its association with psychosis susceptibility gene polymorphisms.
- 2015 Relationship Between Neurosis and Physical Illness  
Taipei Veterans General Hospital (V104C-164)  
PI  
We aim to use Nationwide Health Insurance Claim data to establish the link between neurosis and subsequent risk of physical illness
- 2015-2017 Constructing the Causal Brain Network of Mental Illness  
Ministry of Science and Technology (MOST-104-2314-B-075 -078 -MY2)  
PI

We aim to apply causality analysis to quantify the causal brain networks in healthy subjects and patients with major mental illness.

- 2016 Identifying Objective Polysomnographic Markers of Sleep Quality  
Taipei Veterans General Hospital (V105C-105)  
PI  
We aim to investigate the association between subjective sleep quality and objective PSG marker using novel methods of signal analyses.
- 2015-2017 Developing non-contact sleep monitoring device  
Taipei Veterans General Hospital and HTC Inc.  
We aim to develop a new non-contact radar device to monitor sleep quality and screen sleep apnea by detecting thoracic respiratory activity.

**Current**

- 2016-2018 Dynamical Analysis of System Parameters in Traditional Chinese Medicine  
Ovation Health Institute  
Co-Investigator  
TCM is based on system approach, which can complement the reductionist approach used in western medicine. However, the major weakness of TCM is that it is not a quantitative science. We propose to quantify the fundamental system parameters (such as Yin and Yang), through continuous physiological signals, by applying dynamical analysis tools that were derived from the study of complex systems and statistical physics.
- 2018-2021 Machine Learning Approach to Phenotyping Psychiatric Disorders Using Large-Scale Neuroimaging and GeneChip Data  
Ministry of Science and Techonology  
Co-Investigator  
The goal of the study is to apply machine learning methods to develop neuroimaging and genetic-based classifiers for diagnosing and phenotyping mental disorders.

**Current Unfunded Projects**

None

**Report of Local Teaching and Training**

**Teaching of Students in Courses**

09/09-10/09	Co-Tutor, Problem-based Learning Course	National Yang Ming University, Taipei, Taiwan
	4 <sup>th</sup> Grade Medical Student	6-hr sessions per wk for 8 wks
2011-2016	Medical Psychology	National Yang Ming University, Taipei, Taiwan
	1 <sup>st</sup> Grade Medical Student	2-hr session per course
2011-2016	Clinical Psychiatry	National Yang Ming University, Taipei, Taiwan
	5 <sup>th</sup> Grade Medical Student	2-hr session per course



2017- Present	Biomedical Signal Analysis  Graduate Student	Institute of Brain Sciences, National Yang-Ming University, Taipei, Taiwan 2-hr session per course (total 9 sessions)
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**Formal Teaching of Residents, Clinical Fellows and Research Fellows (post-docs)**

2010-2016	Clinical Skills in Psychiatry  6 <sup>th</sup> Clerkship	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan 3-hr sessions per wk
2011-2016	Sleep Medicine  1 <sup>st</sup> to 3 <sup>rd</sup> year psychiatry resident	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan Lecture
2017- Present	Biomedical Signal Analysis  Research Fellow	Division of Interdisciplinary Medicine and Biotechnology, Beth Israel Deaconess Medical Center Lecture

**Clinical Supervisory and Training Responsibilities**

2011-2016	Clinical Psychiatry  1 <sup>st</sup> to 3 <sup>rd</sup> year psychiatry resident	Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan Ward rounds and bedside teaching
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**Laboratory and Other Research Supervisory and Training Responsibilities**

2012-2016	Supervision of post-doctoral research fellow	Center for Dynamical Biomarkers and Translational Medicine, National Central University, Chungli, Taiwan
2015-Present	Supervision of post-doctoral research fellow	Center for Dynamical Biomarkers, Beth Israel Deaconess Medical Center, Boston, MA

**Formally Supervised Trainees**

2016- Present	Yi-Ju, Lee, 2 <sup>nd</sup> year PhD student at Taiwan International Graduate Program at Academia Sinica, Taipei, Taiwan Brandon Hagor, 1 <sup>st</sup> year PhD student at Brandeis University, USA Wanqing Xie, Post-Doctoral Research Fellow at BIDMC Medicine
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**Formal Teaching of Peers (e.g., CME and other continuing education courses)**

N/A

**Local Invited Presentations**

2004	Who Wrote Shakespeare? Application of Multi-Disciplinary Research to Medicine and Humanity Department of Research and Medical Education, Taipei Veterans General Hospital
2007	Complexity in Medicine Neurological Institute, Taipei Veterans General Hospital

- 2012 Sleep Instability and Major Depression  
Department of Chest, Taipei Veterans General Hospital
- 2012 Sleep Instability and Major Depression  
Department of Chest, Taipei Veterans General Hospital
- 2012 Sleep and Mood Disorder  
Department of Radiology, Taipei Veterans General Hospital
- 2012 From Heart to Sleep: An ECG-based Sleep Monitoring System  
Institute of Brain Sciences, National Yang Ming University, Taipei, Taiwan
- 2013 Complexity analysis of spontaneous brain activity  
National Central University
- 2016 Precision Psychiatry: How Big Neuroimaging Data Can Shape the Future of Psychiatric  
(11/22) Medicine  
National Cheng-Kung University

## **Report of Regional, National and International Invited Teaching and Presentations**

### **Invited Presentations and Courses**

#### **Regional**

- 2012 Sleep and Mood Disorder  
Cardinal Tien Hospital, Taipei, Taiwan
- 2013 Adaptive Analysis of Epidemiological Time Series  
Department of Psychiatry, National Taiwan University Hospital, Taipei, Taiwan
- 2013 Complexity of Mental Illness: A New Research Dimension  
Department of Psychiatry, Tri-Service General Hospital, Taipei, Taiwan
- 2014 China Seminar for autonomic neuroscience and sleep medicine  
SAFE laboratory, Beth Israel Deaconess Medical Center, Boston, USA
- 2018 Brain Sciences and Biomedical Signal Analysis. Beth Israel Deaconess Medical Center.  
Boston, USA

#### **National**

- 2012 Is mental illness complex? From behavior to brain  
51<sup>th</sup> Annual Meeting of Taiwan Psychiatry Association
- 2013 Complexity analysis of resting Fmri signals  
Annual Meeting of Taiwanese Society of Biological Psychiatry and  
Neuropsychopharmacology

#### **International**

- 2006 (4/20) Poincare Plot  
Heart Rate Variability Conference, Harvard Medical School, Boston, MA, USA  
(<http://www.physionet.org/events/hrv-2006/>)
- 2007 (5/21) Sleep instability in major depression  
The 1<sup>st</sup> International Forum on Sleep Medicine and ECO-Health in Humankind, Beijing, China ([www.tcmmit.org.cn](http://www.tcmmit.org.cn))
- 2009 Who Wrote Shakespeare? Application of Multi-Disciplinary Research to Medicine and  
(11/26) Humanity

- Shakespeare in Culture: 4<sup>th</sup> Conference of the National Taiwan University Shakespeare Forum, Taiwan (<http://www.shakespeare.tw>)
- 2011 (4/16) Adaptive Analysis of Epidemiological Time Series  
1<sup>st</sup> International Symposium on Dynamical Biomarkers for Translational Medicine, National Central University, Taiwan (<http://cdbtm.org>)
- 2011 (6/24) Adaptive Analysis of Epidemiological Time Series  
3<sup>rd</sup> International Conference on Hilbert-Huang Transformation: Theory and Applications, Qingdao, China (<http://ldaa.fio.org.cn/>)
- 2012 (3/23) Home-based sleep monitoring system  
2012 UST-UC workshop on wireless healthcare technologies and applications
- 2012 (4/29) Complexity Analysis of Neurophysiological Signals  
2<sup>nd</sup> International Symposium on Dynamical Biomarkers for Translational Medicine, National Central University, Taiwan (<http://cdbtm.org>)
- 2012 (12/7) Who Wrote Shakespeare? Application of Multi-Disciplinary Research to Medicine and Humanity  
Pacific Neighborhood Consortium (PNC) 2012 Annual Conference at University of California, Berkeley, USA
- 2013 (2/16) Complexity of Resting Fmri Signals Differentiates Bipolar Disorder and Schizophrenia  
3<sup>rd</sup> Asian Congress on Schizophrenia Research at Bali, Indonesia
- 2013 (5/26) Multimodal Pressure Flow Analysis to Assess Dynamic Cerebral Autoregulation  
18<sup>th</sup> Meeting of the European Society of Neurosonology and Cerebral Hemodynamics and 3<sup>rd</sup> Meeting of Cerebral Autoregulation Networks (CARNet) at Porto, Portugal
- 2013 (6/26) Complexity of Resting Fmri Signals Differentiates Bipolar Disorder and Schizophrenia  
Young Scientist Award Session, 11<sup>th</sup> World Congress of Biological Psychiatry at Kyoto, Japan
- 2015 (1/11) Innovation in Big Data: A Clinical Perspective  
Microsoft Research, Beijing, China
- 2017 (6/22) Dynamical analysis of brain activity: A new research dimension, 13<sup>th</sup> World Congress of Biological Psychiatry, Copenhagen, Denmark
- 2018 (4/12) Is mental illness complex? From heart to brain. China Pharmaceutical University, Nanjing, China

## **Report of Clinical Activities and Innovations**

### **Current Licensure and Certification**

2002	Taiwan Medical License Registration
2007	Taiwan Psychiatry Board (No. 1095)
2012	Taiwan Sleep Medicine Board (No. 1133)

### **Practice Activities**

2011- 2016	Acute Ward Care	Psychiatry (Taipei Veterans General Hospital)	Daily
2011- 2016	Ambulatory Care	Psychiatry (Taipei Veterans General Hospital)	Two sessions per wk
2015- 2016	Ambulatory Care	Sleep (Taipei Veterans General Hospital)	One session per wk

## Clinical Innovations

Psychiatry-oriented integrative care of patients with sleep disorders

## Report of Technological and Other Scientific Innovations

Information Categorization Method	I have developed the information categorization method with Prof. Chung-Kang Peng and Prof. Ary Goldberger at Harvard Medical School and the method has been applied widely to information carrying sequences, such as heart rate, language, and DNA sequences.
Multimodal Pressure Flow Analysis	I was involved in the development of multimodal pressure flow analysis primarily conducted by Prof. Vera Novak and Prof. Chung-Kang Peng. The method has been used to detect cerebral autoregulation and had significant clinical implications
Electrocardiogram-based Sleep Spectrogram	I have applied the cardiopulmonary coupling analysis developed by Prof. Robert Thomas and Prof. Chung-Kang Peng at Harvard Medical School, to investigate the sleep instability of sleep disturbance in psychiatric patients
Complexity Analysis of fMRI Signals	I have applied the multiscale entropy analysis developed by Dr. Madalena Costa and Prof. Chung-Kang Peng at Harvard Medical School, to investigate the complexity of resting state fMRI signals and to relate the complexity with pathophysiology of mental illness
Causality Analysis – Causal Decomposition Method	I have developed a generic method called causal decomposition analysis for assessing causality that is not based on temporal precedence principle, as involved in Granger causality, but based on the covariation of cause and effect and instantaneous phase dependency.

## Report of Education of Patients and Service to the Community

### Activities

N/A

### Educational Material for Patients and the Lay Community

**Books, monographs, articles and presentations in other media**

N/A

**Educational material or curricula developed for non-professional students**

N/A

**Patient educational material**

N/A

### Recognition

- 2003 Boston Globe (Aug 5, 2003 D1-D4), Cook Gareth: “Much Ado About Data”
- 2003 Chinese Version of Scientific American 科學人雜誌 (2003, 9月號), 曾志朗: “莎翁之謎在於心”

- 2005 Voice of America 美國之音, Authorship Debates in Shakespeare and Dreams of Red Chamber “紅樓夢與莎士比亞作者爭議之謎”
- 2011 Psychiatric News (Jun 17, 2011 46:32), American Psychiatric Association, Joan Arehart-Treichel: “Breathing Polluted Air Linked to Suicide Risk”
- 2011 Significance Magazine, Eoin O'Connell: “The man who wasn't Shakespeare”  
(<http://www.significancemagazine.org/details/webexclusive/1234471/The-man-who-wasnt-Shakespeare--Part-1.html>)
- 2013 Depression and Parkinson's Disease  
New York Times, CBS News, Medical News Today and others (Total of 40 media coverage)

## **Report of Scholarship**

### **Publications**

**H-Index: 27** according to Google Scholar

[https://scholar.google.com/citations?hl=en&user=ii3jdz0AAAAJ&view\\_op=list\\_works&sortby=pubdate&cstart=0&pagesize=20](https://scholar.google.com/citations?hl=en&user=ii3jdz0AAAAJ&view_op=list_works&sortby=pubdate&cstart=0&pagesize=20)

1. **Yang AC**, Hseu SS, Yien HW\*. Prediction of paroxysmal atrial fibrillation by footprint analysis. Computers in Cardiology 28:401-404 (2001).
2. **Yang AC**, Chang CH, Hseu SS, Yien HW\* . Simulating healthy humans heart rate: a Markovian model. Computers in Cardiology 29:229-232 (2002).
3. **Yang AC**, Hseu SS, Yien HW\*, Goldberger AL, Peng CK. Linguistic analysis of human heartbeats using frequency and rank order statistics. Physical Review Letters 90:108103 (2003).
4. **Yang AC\***, Peng CK, Yien HW, Goldberger AL. Information categorization approach to literary authorship disputes. Physica A 329:473-483 (2003).
5. **Yang AC\***, Hseu SS, Yien HW, Goldberger AL, Peng CK. Reply: Comment on Linguistic analysis of human heartbeats using frequency and rank order statistics. Physical Review Letters 92:109802 (2003).
6. Novak V\*, **Yang AC**, Lepicovsky L, Goldberger AL, Lipsitz LA, Peng CK. Multimodal pressure-flow method to assess dynamics of cerebral autoregulation in stroke and hypertension. BioMedical Engineering Online 3:39 (2004).
7. **Yang AC**, Goldberger AL, Peng CK.\* Genomic classification using an information-based similarity index: application to the SARS coronavirus. Journal of Computational Biology 12(8):1103-16 (2005).
8. Peng CK\*, **Yang AC**, Goldberger AL. Statistical physics approach to categorize biologic signals: from heart rate dynamics to DNA sequences. Chaos 17: 015115 (2007).

9. **Yang AC\***, Tsai SJ, Hong CJ , Hsieh CH, Liu ME, Yang CH. Association between heart rate variability and cognitive function in elderly community-dwelling men without dementia: a preliminary report. *Journal of the American Geriatrics Society* 56(5):958-60 (2008).
10. Cheng D, Tsai SJ, Hong CJ, **Yang AC\***. Reduced physiologic complexity of heart rate dynamics in healthy elderly men with APOE  $\epsilon$ 4 allele. *PLoS ONE* 4(11):e7733 (2009).
11. **Yang AC\***, Chen TJ, Tsai SJ, Hong CJ, Kuo CH, Yang CH, Kao KP.\* BDNF Val66Met polymorphism alters sympathovagal balance in healthy subjects. *American Journal of Medical Genetics B* 153B(5):1024-30 (2010) .
12. **Yang AC**, Hong CJ, Tsai SJ.\* Heart rate variability in psychiatric disorders. *Taiwanese Journal of Psychiatry* 24:99-109 (2010).
13. **Yang AC\***, Hong CJ, Kuo CH , Chen TJ, Yang CH, Li C, Tsai SJ. Profiling objective sleep quality in a healthy Taiwanese sample using a novel electrocardiogram-based cardiopulmonary coupling analysis. *Taiwanese Journal of Psychiatry*, 24:201-09 (2010).
- 14 . **Yang AC\***, Tsai SJ, Yeh HL, Chen JY, Liou YJ, Huang JP, Hong CJ. Association of renal function and cognitive performance in elderly community-dwelling men without dementia. *Journal of the American Geriatrics Society* 58(10): 2046-8 (2010).
15. **Yang AC\***, Huang NE, Peng CK, Tsai SJ.\* Do seasons have an influence on the incidence of depression? The use of an internet search engine query data as a proxy of human affect. *PLoS ONE* 5(10):e13728 (2010).
16. **Yang AC\***, Tsai SJ, Huang NE. Decomposing the association of completed suicide with air pollution, weather, and unemployment data at different time scales. *Journal of Affective Disorders* 129:275-281 (2011).
17. **Yang AC\***, Yang CH, Hong CJ, Tsai SH, Kuo CH, Peng CK, Mietus JE, Goldberger AL, Thomas RJ. Sleep state instabilities in major depression: detection and quantification with an Electrocardiogram-based spectrogram method. *Psychophysiology* 48:285-291 (2011).
18. **Yang AC\***, Tsai SJ, Yang CH, Kuo CH, Chen TJ, Hong CJ.\* Reduced physiologic complexity is associated with poor sleep in patients with major depression and primary insomnia. *Journal of Affective Disorders* 131:179-185 (2011).
19. **Yang AC**, Fuh JL, Huang NE, Peng CK, Wang SJ.\* Temporal associations between weather and headache: analysis by empirical mode decomposition. *PLoS ONE* 6(1):e14612 (2011).
20. Chen SP, Fuh JL, Wang SJ, Tsai SJ, Hong CJ, **Yang AC**. Brain- derived neurotrophic factor gene Val66Met polymorphism modulates reversible cerebral vasoconstriction syndromes. *PLoS ONE* 6(3): e18024 (2011).

21. Chiu YH, **Yang AC**, Chern CH\*, How CK. Myasthenic crisis may mimic antipsychotic-induced extrapyramidal syndromes. *The Journal of Neuropsychiatry and Clinical Neurosciences* 23(2):e36-37 (2011).
22. **Yang AC\***, Tsai SJ\*, Hong CJ, Wang C, Chen TJ, Liou YJ, Peng CK. Clustering heart rate dynamics is associated with  $\beta$ -adrenergic receptor polymorphisms: analysis by information-based similarity index. *PLoS ONE* 6(5): e19232 (2011).
23. **Yang AC\***, Tsai SJ, Huang NE, Peng CK. Association of Internet search trends with suicide death in Taipei city, Taiwan, 2004-2009. *Journal of Affective Disorders* 132:179-184 (2011).
24. Yeh HL, Hou SJ, Yen FC, Hong CJ, Liou YJ, **Yang AC**, Liu ME, Tsai SJ\*. Polymorphisms in LMNA and near a SERPINA13 gene are not associated with cognitive performance in Chinese elderly males without dementia. *Neuroscience Letters* 504(1):32-34 (2011).
25. Tsai SJ\*, Hong CJ, Yeh HL, Liou, YJ, **Yang AC**, Liu, ME, Huang JP\*. Heterozygote Advantage of the MTHFR C677T Polymorphism on Specific Cognitive Performance in Elderly Chinese Males without Dementia. *Dementia and Geriatric Cognitive Disorders* 32:159-163 (2011).
26. Tsai SJ\*, Yeh HL, Hong CJ, Liou, YJ, **Yang AC**, Liu, ME, Huang JP\*. Association of CHRNA4 polymorphism with depression and loneliness in elderly males. *Genes, Brain and Behavior* 11(2) :230-4 (2011).
27. Lan WH, **Yang AC**, Hwang JP, Hong CJ, Liou YJ, Yeh HL, Liu ME, Tsai SJ. Association of MTHFR C677T polymorphism with loneliness but not depression in cognitively normal elderly males. *Neuroscience Letters* 521(1):88-91 (2012).
28. Tsai A, Huang CC, **Yang AC**, Liu ME, Tu PC, Hong CJ, Liou YJ, Chen JF, Lin CP\*, Tsai SJ\*. Association of BACE1 Gene Polymorphism with Cerebellar Volume but Not Cognitive Function in Normal Individuals. *Dementia and Geriatric Cognitive Disorders Extra* 2:632–637 (2012).
29. Liu ME, Huang CC, Hwang JP, **Yang AC**, Tu PC, Yeh HL, Hong CH, Liou YJ, Chen JF, Lin CP\*, Tsai SH\*. Effect of Bcl-2 rs956572 SNP on regional gray matter volumes and cognitive function in elderly males without dementia. *Age* 35(2):343-52 (2013).
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#### Peer reviewed publications in print or other media

**Yang AC**, Peng CK, Goldberger AL. **The Calvin & Rose G Hoffman Marlowe Memorial Trust 2003 Prize**, “*The Marlowe-Shakespeare authorship debate: approaching an old problem with new methods.*”

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N/A

#### Professional educational materials or reports, in print or other media

**Yang AC**, Peng CK, Goldberger AL. IBS: Information-Based Similarity

URL: <http://www.physionet.org/physiotools/ibs/>

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### Clinical Guidelines and Reports

N/A

### Thesis

Adaptive Analysis of Epidemiological Time Series (2011)

Supervisor: Prof. Norden E. Huang

### Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings

1. **Yang AC**, Goldberger AL, Peng CK. Linguistic analysis of human heartbeat. Taiwan Heart Rate Variability Conference, Taipei Veterans General Hospital (2003).
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### **Narrative Report (limit to 500 words)**

Dr. Yang is the Principal Investigator of Laboratory of Precision Psychiatry (<http://precisionpsychiatry.org>). The major study focus of Dr. Albert C. Yang is the detection of hidden information in neurophysiological signals using techniques adapted from physics and nonlinear dynamics. Dr. Yang aims to apply these novel analyses to investigate the pathophysiology of mental illness. Dr. Yang has a background in psychiatric medicine trained at Taipei Veterans General Hospital, Taiwan (2004-2009), and specific training in nonlinear dynamics at Margret and H. A. Rey Institute for Nonlinear Dynamics in Medicine, Beth Israel Deaconess Medical Center/Harvard Medical School. As a postdoctoral fellow at Harvard (2002-2004), Dr. Yang has applied methods from statistical physics, linguistics, and information theory to develop an information-based similarity (IBS) index, to quantify the similarity between different types of information-carrying sequences, ranging from heart rate time series, literary authorship debates, and SARS virus genome. The IBS algorithm has been essentially included in the Physionet, a National Institute of Health (NIH) research resource for complex signals (<http://www.physionet.org/physiotools/ibs/>).

As an attending psychiatrist (2009-2016), Dr. Yang applied multiscale entropy analysis to quantifying the complexity of heart rate dynamics in aging and mental illness, spontaneous brain activities measured by both electroencephalogram, and resting-state functional magnetic resonance imaging. Dr. Yang has proposed a theory of brain complexity in explaining the pathophysiology of mental illness and led a special issue in Progress of Neuropsychopharmacology and Biological Psychiatry. Dr. Yang also won the Young Scientist Award in 2013 World Congress of Biological Psychiatry for the work of complexity analysis of neuroimaging in bipolar disorders and schizophrenia. Beginning in 2015, Dr. Yang has collaborated with Prof. Keshavan at Department of Psychiatry, Beth Israel Deaconess Medical Center (BIDMC) to apply methods of nonlinear dynamics to the resting-state fMRI signals obtained from Bipolar and Schizophrenia Network for Intermediate Phenotypes (BSNIP) project.

Another focus of Dr. Yang is to investigate the mechanisms of sleep instability in insomnia. Dr. Yang has applied a cardio-pulmonary coupling analysis, a method of measuring physiologic sleep stability developed by Dr. Robert Thomas and Dr. Chung-Kang Peng at BIDMC, to quantify the sleep in healthy, depression, and the effect of shift work on medical intern's sleep stability. Dr. Yang has led to found the integrative sleep medicine center at Taipei Veterans General Hospital, Taiwan in 2013.

In addition, Dr. Yang has also applied an adaptive data analysis algorithm, Hilbert-Huang Transform, developed by Dr. Norden E. Huang at NASA, to cerebral auto-regulations, and adaptive analysis of neuro-psychiatric epidemiology. Several epidemiological works published by Dr. Yang have been recognized internationally. The study of internet search trends for depression has been cited widely. The study of suicide and air pollution has been recognized in Psychiatric News (2011 46:32; Joan Arehart-Treichel: "Breathing Polluted Air Linked to Suicide Risk"), and the study of suicide and internet search trend has been awarded Travel Award in the Annual Meetings of 2012 European

Psychiatric Association. The study of depression and Parkinson's disease has been reported by worldwide media including New York Times and Columbia Broadcasting System.

Recently, Dr. Yang developed a novel method for assessing causality in time series. The method is called causal decomposition analysis based on covariation of cause and effect, and may overcome the limitation of Granger causality based on temporal precedence principle between cause and effect. The method can be applied to both stochastic and deterministic system and is shown to uncover key mode of causal interaction in ecosystem, physiology, and functional brain imaging data (Nature Communications 2018;9:3378).