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NSS-MIC, Seoul

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- Equipment support from Intel

Big Thanks

Sue Cutler

Les Rogers

Yoram Bresler & Al Macovski

Past E. J. Hoffman MIS award recipients

- 1996 Robert N Beck, University of Chicago
- 1998 **W Leslie Rogers, University of Michigan**
- 2000 Harrison H Barrett, University of Arizona
- 2002 Edward J Hoffman, University of California - Los Angeles
- 2004 Gerd Muehlelehner, ADAC UGM
- 2006 Ronald J Jaszczak, Duke University
- 2007 Ronald H Huesman, Lawrence Berkeley Laboratory
- 2008 Christopher J Thompson, McGill University
- 2009 Benjamin M W Tsui, Johns Hopkins University
- 2010 Richard Leahy, University of Southern California
- 2011 Michel Defrise, Vrije Universiteit Brussels
- 2012 Simon Cherry, University of California, Davis

UM Nuclear Medicine Colleagues

Neal Clinthorne

Yuni Dewaraja

Ed Ficarò

Gary Hutchins

Bob Koeppe

Ken Koral

David Kuhl

Les Rogers

UM Collaborators

Engineering

- Zhong He
- Al Hero
- Jon-Fredrik Nielsen
- Doug Noll
- Tom Wensch
- Scott Wilderman
- ...

Radiology

- Tom Chenevert
- Mitch Goodsitt
- Ella Kazerooni
- Charles Meyer
- ...

Radiation Oncology

- James Balter
- ...

External Collaborators

Too many to list...

GE collaborators

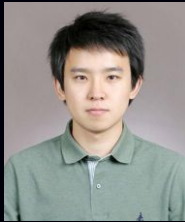
- Bruno De Man
- Jean-Baptiste Thibault
- and many more...

Current students and postdocs

CT group



Jang Hwan
Cho



Donghwan
Kim



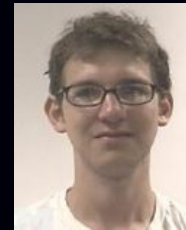
Jungkuk
Kim



Madison
McGaffin



Hung
Nien



Stephen
Schmitt



Dan
Weller

MR group



Michael
Allison



Jean
Kwon



Mai
Le



Matthew
Muckley



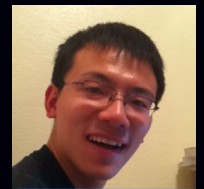
Gopal
Nataraj



Hao
Sun



Sydney
Williams



Feng
Zhao

Postdoc

Past students and postdocs



Sangtae
Ahn



Eran
Bashan



Roshni
Bhagalia



Se Young
Chun



Idris
ElBakri



Hakan
Erdoğan



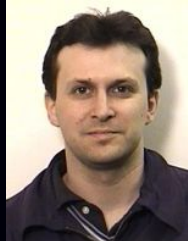
Amanada
Funai



Amir
Ghanei



Wonseok
Huh



Matt
Jacobson



Aniket
Joshi



Kim
Khalsa



Jeongtae
Kim



Sumati
Krishnan



Catherine
June



Sangwoo
Lee



Dan
Lingenfelter



Yong
Long



Ray
Maleh



Antonis
Matakos



Ram
Narayanan



Joonki
Noh



Valur
Olafsson



Hyunjin
Park

continued



Sathish
Ramani



Dan
Ruan



Hugo
Shi



Nan
Sotthivirat



Somesh
Srivastava



Web
Stayman



Predrag
Sukovic



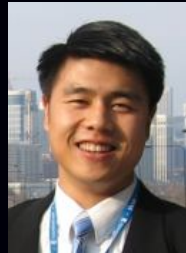
Brad
Sutton



Stephen
Titus



John
Valenzuela



Ted
Way



Mehmet
Yavuz



Anastasia
Yendiki



Desmond
Yeo



Chun-yu
Yip



Daehyun
Yoon



Dan
Yu



Yingying
Zhang

Unfinished business

Joint emission / attenuation reconstruction

IEEE NSS/MIC 1991, p. 1927-32

Joint Maximum Likelihood Estimation of Emission and Attenuation Densities in PET

Neal H. Clinthorne, Jeffrey A. Fessler, Gary D. Hutchins, and W. Leslie Rogers
The University of Michigan, Division of Nuclear Medicine
Ann Arbor, MI 48109-0552.

IEEE TRANSACTIONS ON NUCLEAR SCIENCE VOL. 40, NO. 4, AUGUST 1993

1055

On complete-data spaces for PET reconstruction algorithms

Jeffrey A. Fessler, Neal H. Clinthorne, and W. Leslie Rogers
University of Michigan

See first three (!) talks in image reconstruction section this afternoon!
TOF-PET ...

Multi-modality image reconstruction

1464

IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 39, NO. 5, OCTOBER 1992

Regularized Emission Image Reconstruction Using Imperfect Side Information

Jeffrey A. Fessler*, Neal H. Clinthorne, and W. Leslie Rogers
Division of Nuclear Medicine, University of Michigan

Fast, convergent image reconstruction

2664

IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 42, NO. 10, OCTOBER 1994

Space-Alternating Generalized Expectation-Maximization Algorithm

Jeffrey A. Fessler, *Member, IEEE*, and Alfred O. Hero, *Member, IEEE*

IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 4, NO. 10, OCTOBER 1995

1417

Penalized Maximum-Likelihood Image Reconstruction Using Space-Alternating Generalized EM Algorithms

Jeffrey A. Fessler, *Member, IEEE*, and Alfred O. Hero, III, *Member, IEEE*

Fast ordered-subsets image reconstruction

Phys. Med. Biol. **44** (1999) 2835–2851. Printed in the UK

PII: S0031-9155(99)

Ordered subsets algorithms for transmission tomography

H Erdođan and J A Fessler

4415 EECS Building, 1301 Beal Avenue, University of Michigan, Ann Arbor, MI 48109-

Improving convergence properties:

Session M19 #6 (Fri. 15:15)

“Accelerating ordered subsets with relaxed momentum for X-ray CT image reconstruction,” Donghwan Kim, JF

Regularization design

IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 5, NO. 3, MARCH 1996

493

Mean and Variance of Implicitly Defined Biased Estimators (Such as Penalized Maximum Likelihood): Applications to Tomography

Jeffrey A. Fessler, *Member, IEEE*

1346

IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 5, NO. 9, SEPTEMBER 1996

Spatial Resolution Properties of Penalized-Likelihood Image Reconstruction: Space-Invariant Tomographs

Jeffrey A. Fessler, *Member, IEEE*, and W. Leslie Rogers, *Member, IEEE*

Sangtae Ahn, R M Leahy: "Analysis of resolution and noise properties of **nonquadratically** regularized image reconstruction methods for PET," IEEE T-MI, Mar. 2008.

Fri. Poster M22 #31

"**Quadratic** regularization design for 3D axial CT: Towards isotropic noise," Jang Hwan Cho, JF

Motion-compensated image reconstruction

IEEE NSS/MIC 2003. p. 3290-4

Joint Estimation of Image and Deformation Parameters in Motion-Corrected PET

M.W. Jacobson and J.A. Fessler

“Noise properties of motion-compensated tomographic image reconstruction methods,” IEEE T-MI, Feb. 2013;

“Spatial resolution properties of motion-compensated image reconstruction methods,” IEEE T-MI, Jul. 2012; Se Young Chun, JF

Fri. Poster M22 #36

“Motion-compensated image reconstruction for cardiac CT with sinogram-based motion estimation,” Jang Hwan Cho, JF

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References

- [1] N. H. Clinthorne, J. A. Fessler, G. D. Hutchins, and W. L. Rogers. Joint maximum likelihood estimation of emission and attenuation densities in PET. In *Proc. IEEE Nuc. Sci. Symp. Med. Im. Conf.*, volume 3, pages 1927–32, 1991.
- [2] J. A. Fessler, N. H. Clinthorne, and W. L. Rogers. On complete data spaces for PET reconstruction algorithms. *IEEE Trans. Nuc. Sci.*, 40(4):1055–61, August 1993.
- [3] J. A. Fessler, N. H. Clinthorne, and W. L. Rogers. Regularized emission image reconstruction using imperfect side information. *IEEE Trans. Nuc. Sci.*, 39(5):1464–71, October 1992.
- [4] J. A. Fessler and A. O. Hero. Space-alternating generalized expectation-maximization algorithm. *IEEE Trans. Sig. Proc.*, 42(10):2664–77, October 1994.
- [5] J. A. Fessler and A. O. Hero. Penalized maximum-likelihood image reconstruction using space-alternating generalized EM algorithms. *IEEE Trans. Im. Proc.*, 4(10):1417–29, October 1995.
- [6] H. Erdoğan and J. A. Fessler. Ordered subsets algorithms for transmission tomography. *Phys. Med. Biol.*, 44(11):2835–51, November 1999.
- [7] D. Kim and J. A. Fessler. Accelerating ordered subsets with relaxed momentum for X-ray CT image reconstruction. In *Proc. IEEE Nuc. Sci. Symp. Med. Im. Conf.*, 2013. To appear.
- [8] J. A. Fessler. Mean and variance of implicitly defined biased estimators (such as penalized maximum likelihood): Applications to tomography. *IEEE Trans. Im. Proc.*, 5(3):493–506, March 1996.
- [9] J. A. Fessler and W. L. Rogers. Spatial resolution properties of penalized-likelihood image reconstruction methods: Space-invariant tomographs. *IEEE Trans. Im. Proc.*, 5(9):1346–58, September 1996.
- [10] S. Ahn and R. M. Leahy. Analysis of resolution and noise properties of nonquadratically regularized [19](#)

- image reconstruction methods for PET. *IEEE Trans. Med. Imag.*, 27(3):413–24, March 2008.
- [11] J. H. Cho and J. A. Fessler. Quadratic regularization design for 3D axial CT: Towards isotropic noise. In *Proc. IEEE Nuc. Sci. Symp. Med. Im. Conf.*, 2013. To appear.
- [12] M. W. Jacobson and J. A. Fessler. Joint estimation of image and deformation parameters in motion-corrected PET. In *Proc. IEEE Nuc. Sci. Symp. Med. Im. Conf.*, volume 5, pages 3290–4, 2003.
- [13] S. Y. Chun and J. A. Fessler. Spatial resolution properties of motion-compensated image reconstruction methods. *IEEE Trans. Med. Imag.*, 31(7):1413–25, July 2012.
- [14] S. Y. Chun and J. A. Fessler. Noise properties of motion-compensated tomographic image reconstruction methods. *IEEE Trans. Med. Imag.*, 32(2):141–52, February 2013.
- [15] J. H. Cho and J. A. Fessler. Motion-compensated image reconstruction for cardiac CT with sinogram-based motion estimation. In *Proc. IEEE Nuc. Sci. Symp. Med. Im. Conf.*, 2013. To appear.