

## Urvashi Rao Venkata

### **Associate Scientist (Computational Science)**

National Radio Astronomy Observatory,  
1003 Lopezville Road, Socorro, NM 87801  
(Off) 1-575-835-7372, (Cell) 1-575-418-5567  
Email : *rurvashi@ao.nrao.edu*

### Research Interests

Algorithm research and software development for image reconstruction, signal calibration and image/data analysis, applied to radio interferometers and radio astronomy.

- Application of numerical optimization techniques to inverse problems in image reconstruction.
- Algorithms for the detection and removal of electromagnetic interference.
- Algorithms for calibration of radio-frequency receivers.
- Simulations and metrics to quantify algorithmic limits.
- Parallel and high-performance computing, data visualization.

### Work Experience

- **Associate Scientist - CS**, National Radio Astronomy Observatory, Socorro [Mar 2014 - present]
- **Assistant Scientist - CS**, National Radio Astronomy Observatory, Socorro [Aug 2010 - Mar 2014]
- **NRAO Reber Fellow**, National Radio Astronomy Observatory, Socorro [Jan 2008 - May 2010]
- **Graduate Intern**, National Radio Astronomy Observatory, Socorro [Aug 2007 - Dec 2007]  
[Jul 2003 - Sep 2003]
- **Software Developer**, National Radio Astronomy Observatory, Socorro [Sep 2004 - Jul 2007]
- **Teaching Assistant** Dept. of Computer Sc. & Engineering., UC San Diego [Apr 2004 - Jun 2004]  
[Apr 2003 - Jun 2003]
- **Research Assistant** Dept. of Computer Sc. & Engineering., UC San Diego [Sep 2003 - Mar 2004]  
[Sep 2002 - Mar 2003]
- **Undergraduate Intern**, National Centre for Radio Astrophysics, Pune [Jan 2002 - Jun 2002]

### Educational Qualifications

- Ph.D. Physics** Aug 2004 - May 2010  
New Mexico Institute of Mining and Technology, Socorro, NM, USA  
*Dissertation:* "Parameterized Deconvolution for Wide-Band Radio Synthesis Imaging"
- M.S. Computer Science (Scientific Computing)** Sep 2002 - Jun 2004  
University of California, San Diego, CA, USA  
*Thesis:* "A performance model and load balancer for a Parallel Monte-Carlo Cellular Microphysiology Simulator"
- M.Sc.(Hons.) Physics & B.E.(Hons.) Computer Science** Aug 1997 - Jun 2002  
Birla Institute of Technology and Science, Pilani, India

## Work Experience Details

- **Assistant Scientist - CS**, National Radio Astronomy Observatory, Socorro, NM, USA [Aug 2010 - Mar 2014]
  - Implemented an algorithm for the simultaneous reconstruction of the intensity and spectrum of the sky from wideband VLA data. Combined this algorithm with another that applies direction-dependent instrumental corrections. Deployed and commissioned both methods as part of the CASA package.
  - Performed detailed use-case simulations to quantify deep imaging limits of the wideband VLA.
  - Developed an algorithm for interferometric imaging of structure that varies with both time and frequency and demonstrated its use on simulated observations of solar flares.
  - Coordinated the software refactoring of two modules of the CASA package to make several new algorithm combinations available and to increase flexibility, reliability and the ease of maintenance and feature additions.
  - Supervised 3 student projects. (a) Comparison of linear-algebraic pattern extraction techniques for radio frequency interference mitigation. (b) Simulated study of the imaging confusion limits of the VLA interferometer, (c) Evaluation of antenna primary beam models for the ALMA telescope to understand how accurately they need to be known in order to achieve the required image precision.
- **NRAO Reber Fellow**, National Radio Astronomy Observatory, Socorro, NM, USA [Aug 2007 - May 2010]
  - Prototyped and validated two wideband image reconstruction algorithms for radio interferometers.
  - Performed a linear algebraic analysis of the imaging process in radio interferometry to classify several existing methods within a common mathematical framework and to demonstrate conceptual relations between them.
- **Programmer (part-time)**, National Radio Astronomy Observatory, Socorro, NM, USA [Sep 2004 - Jul 2007]
  - Designed and implemented an interactive data visualization tool for the display of radio interferometry data, allowing for the generation, storage and access of user-defined masks to tag data for removal.
  - Conducted a user survey to get a list of required features for a mask generation tool, and implemented a subset of these requests while porting an existing code module to a newer system.
- **Graduate Intern**, National Radio Astronomy Observatory, Socorro, NM, USA [Summer 2003, 2004]
  - Tested the limits of existing narrow-band image reconstruction methods in the context of an ongoing wideband upgrade to the VLA telescope. Developed a hybrid wideband imaging method.
  - Used the Bayesian interpretation of image reconstruction to develop a Markov-Chain Monte-Carlo algorithm for optimal modeling of smooth and diffuse spatial structure by a flexible set of overlapping Gaussians.
- **Research / Teaching Assistant**, Dept. of Computer Science, UC San Diego, CA, USA [Sep 2002 - Jun 2004]
  - Developed a predictive performance model and load balancer for a parallel 3D cell microphysiology simulator, using a dynamic domain decomposition scheme that preserved locality and minimized communication.
  - Discussion sessions and grading for the *Introduction to High Performance and Parallel Computing* course.
- **Undergraduate Intern**, National Centre for Radio Astrophysics, Pune, India [Jan 2002 - Jun 2002]
  - Developed a pattern recognition algorithm to automate the identification and removal of radio-frequency interference from measurements taken with an interferometer. Later implemented in the CASA package.
  - Implemented and compared numerical solvers based on least-squares methods and eigen decompositions of a correlation matrix, to extract instrumental cross-polar gains and leakages to calibrate a radio interferometer.
- **Undergraduate Intern**, Texas Instruments, Bangalore, India [Jul 2001 - Dec 2001]
  - Software debugging for an early prototype of an e-book reader.
- **Study Projects**, Birla Institute of Technology and Science, Pilani, Rajasthan, India [Jan 2000 - May 2001]
  - Studied and implemented algorithms for computer axial tomography, radio interferometry, fragile watermarking for digital image security, wavelet image compression and simulated water table evolution around a well.
  - Built a simple antenna and receiver system to detect decametric radio bursts from Jupiter.

### Journal Publications

- *Wide-field wide-band full polarization interferometric imaging: The WB A-Projection algorithm*, Bhatnagar,S. , **Rau,U.**, Golap,K. ,Astrophysical Journal, Volume 770, issue 2, id 91, pp.9, June 2013.
- *A Group Sparsity Imaging Algorithm for Transient Radio Sources*, Wenger, S., **Rau,U**, Magnor,M., Astronomy and Computing, Volume 1, pp 40-45, February,2013.
- *"A multi-scale multi-frequency deconvolution algorithm for synthesis imaging in radio-interferometry"*, **U.Rau**, T.J.Cornwell, Astronomy and Astrophysics, Volume 532, A71, August 2011.
- *"Deep Radio Continuum Imaging of the Dwarf Irregular IC 10: Tracing Star Formation and Magnetic Fields"*, Volker Heesen, **U. Rau**, Michael P. Rupen, Elias Brinks, Deidre Hunter, The Astrophysical Journal Letters, Volume 739, Issue 1, L23, September 2011.
- *"EVLA Observations of Galactic Supernova Remnants: wide-field continuum and spectral-index imaging"*, Sanjay Bhatnagar, **U. Rau**, David A. Green, and Michael P. Rupen, The Astrophysical Journal Letters, Volume 739, Issue 1, L20, September 2011.
- *"SparseRI: A Compressed Sensing Framework for Aperture Synthesis Imaging in Radio Astronomy"*, Wenger, S. Magnor, M. Pihlstrm, Y. Bhatnagar, S. **Rau, U.**, Publications of the Astronomical Society of the Pacific, Volume 122, issue 897, pp.1367-1374.
- *"Advances in Calibration and Imaging Techniques in Radio Interferometry"*, **U.Rau**, S.Bhatnagar, M.A.Voronkov, T.J.Cornwell, Proceedings of the IEEE, Vol.97, No.8, p-1472, August 2009.

### Publications currently in preparation

- *Wide-band mosaic imaging in radio interferometry*, **Rau,U.**, Bhatnagar,S. , Golap, K
- *A study of the reconstruction accuracy of intensity and spectral index of faint sources in wideband radio-interferometric imaging* , **Rau,U.**, Bhatnagar,S. , Owen, F.
- *Re-interpreting mosaic observations in radio interferometry*, Bhatnagar,S., **Rau,U**, Golap,K.

### Conference Proceedings

- *"Radio interferometric imaging of spatial structure that varies with time and frequency"*, **U.Rau**, Proceedings of SPIE Optical Engineering + Applications, Image Reconstruction from Incomplete Data VII, August 2012.
- *"Monte-Carlo Image analysis in Radio Interferometry"*, **U.Rau**, T.J.Cornwell, Astronomical Data Analysis Software and Systems XIV ASP Conference Series, Vol. 347, p-168 2004
- *"Solving for Polarization Leakage in Radio Interferometers Using Unpolarized Sources"*,Bhatnagar S., **Urvashi R.V.**, Nityananda R., Astronomical Data Analysis Software and Systems XII ASP Conference Series, Vol. 295, p-469 2003.

### Theses

- *"Parameterized Deconvolution for Wide-Band Radio Synthesis Imaging"*, **Urvashi R.V.**, Ph.D. Dissertation, New Mexico Institute of Mining and Technology, Socorro, NM, USA, May 2010.
- *"A performance model and load balancer for a Parallel Monte-Carlo Cellular Microphysiology Simulator"*, **Urvashi R.V.**, M.S. Thesis, University of California, San Diego, June 2004.

### Memos / Technical Reports

- “*Convention for UVW calculations in CASA*”, **U.Rau**, CASA Memo, 2013.
- “*Flagging in CASA 3.4*”, S.Castro, **U.Rau**, J.Gonzales, CASA documentation, 2012/2013.
- “*Imaging Algorithms in CASA*”, **U.Rau**, CASA documentation, 2010/2011/2012/2013.
- “*Casapy Flag tool and casa::Flagger*”, **U. Rau**, CASA Programmers Note, 23 August 2007
- “*Design of casa::TablePlot for Casapy*”, **U. Rau**, CASA Programmers Note, 18 August 2007
- “*Multi Frequency Synthesis Imaging for the EVLA : An initial investigation*”, **Urvashi R.V.**, T.J.Cornwell, S.T.Myers, EVLA Memo 101, April 2006
- “*Monte Carlo Methods for Bayesian Image Reconstruction and Analysis in Radio Astronomy*”, **Urvashi R.V.**, T.J.Cornwell, EVLA Memo 102, February 2006
- “*Automatic RFI identification and flagging*”, **Urvashi R.V.**, A. Pramesh Rao, NCRA Technical Report No. R00202, October 1 2003

### Reviewing Experience

- Astronomy and Astrophysics (2010, 2013, 2014)
- Publications of the Astronomical Society of the Pacific (2013)
- Monthly Notices of the Royal Astronomical Society (2013)
- Bulletin of the Astronomical Society of India (2011)

### Selected Research Talks

- “*Wideband Mosaics - Accuracy of deep imaging surveys*” , Talk at the Meter Wavelength Sky conference, 12 Dec 2013, GMRT/NCRA, Pune, India.
- “*How accurately do our imaging algorithms reconstruct intensities and spectral indices of weak sources?*”
  - Wednesday-Lunch talk at the NRAO/SOC, 13 Nov 2013, Socorro, NM, USA
  - Talk at the 29th Annual New Mexico Symposium, 17 January 2014, Socorro, NM, USA
- “*Wideband mosaics*”, Talk at the Seventh SKA Calibration and Imaging workshop (all participants invited), 5 December 2012, Cape Town, South Africa
- “*Radio Interferometric Imaging of spatial structure that varies with time and frequency*”,
  - Talk at the SPIE Optical Engineering+Applications Meeting, 15 August 2012, San Diego, CA, USA
  - Wednesday-Lunch talk at the NRAO/SOC, 29 August 2012, Socorro, NM, USA
  - Talk at the ATNF/CASS,CSIRO, 18 September 2012, Sydney,Australia.
- “*Sky-domain algorithms to reconstruct spatial, spectral and time-variable structure of the sky-brightness distribution*”, Colloquium at the National Centre for Radio Astrophysics, TIFR, 2 July 2012, Pune, India.
- “*Correcting for wide-band primary-beam effects during imaging and deconvolution*”, Wednesday Lunch talk at the NRAO/SOC, 28 March 2012, Socorro, NM, USA.
- “*Synthesis Imaging in Radio Astronomy - Reconstructing spatial and spectral structure of an astronomical source*”, Talk at the Biomedical and Astronomical Signal Processing (BASP) Frontiers Workshop (all participants invited), 06 September 2011, Villars, Switzerland.

- *"Multi-frequency synthesis and wide-field imaging with the EVLA"*, Talk at the URSI General Assembly, 17 August 2011, Istanbul, Turkey,
- *"Recent Imaging Results with EVLA data, and lessons learnt so far"*, Talk at the Sixth SKA Calibration and Imaging Workshop (all participants invited), 26 July 2011, Manchester, UK (via Skype).
- *"Pilot Project for an EVLA wide-band Galactic-plane survey : first results"* , Talk at the 26th Annual New Mexico Symposium, 5 November 2010, Socorro, NM, USA.
- *"A few imaging results using wide-band EVLA data"*, Wednesday Lunch talk at the NRAO/SOC, 3 November 2010, Socorro, NM, USA.
- *"Wide-field Wide-band image reconstruction with the EVLA"*, Physics Seminar at the Univ. of New Mexico Physics Dept., 30 September 2010, Albuquerque, NM, USA.
- *"Feasibility of wide-band imaging (using MS-MFS)"*, Talk at the Fifth SKA Calibration and Imaging workshop (all participants invited), 23 August 2010, Dwingeloo, The Netherlands.
- *"Wide-Field Wide-Band Imaging in Radio Interferometry"*, Colloquium at the National Centre for Radio Astrophysics, 12 July 2010, Pune, India
- *"Parameterized Deconvolution for Wide-Band Radio Synthesis Imaging"*, Colloquium / PhD Thesis defense, 17 May 2010, Socorro, NM, USA
- *"Wide-Field Wide-Band Imaging with the EVLA"*, Talk at the 215<sup>th</sup> American Astronomical Society (AAS) meeting, 6 January 2010, Washington D.C., USA
- *"Wide-Field Wide-Band Imaging in Radio Interferometry"*, Talk at the ATNF Student Symposium, 16 June 2009, Sydney, AU (via audio link from Socorro)
- *"Remote Sensing, Image Making and Radio Telescopes "*, Colloquium at the New Mexico Tech Physics Department, 09 Apr 2009, Socorro, USA
- *"Wide-Field Wide-Band Imaging with the EVLA - initial results"*, Talk at the Fourth SKA Calibration and Imaging Workshop (all participants invited), 31 March 2009, Socorro, USA
- *"Multi Frequency Synthesis Imaging with Wideband EVLA data"*, Lunch Talk at the EVLA Advisory Committee Meeting, 19-20 March 2009, Socorro, USA
- *"Multi-Frequency Synthesis Imaging with Multi-Scale Deconvolution (EVLA, e-MERLIN)"*, Talk at the Workshop on Imaging and Calibration Algorithms for EVLA, eMERLIN and ALMA, 02 December 2008, Oxford, UK (via video link from Socorro)
- *"Multi-Frequency Synthesis Imaging with Wide-Band (E)VLA data"*, Talk at the 24th Annual New Mexico Symposium, 24 October 2008, Socorro, USA
- *"Multi-Frequency Synthesis Imaging with Multi-Scale Deconvolution"*, Invited Talk at the XXIX URSI General Assembly, 15 August 2008, Chicago, USA
- *"Wide-Band Imaging - Algorithms and Errors"*, Talk at the Third SKA Calibration and Imaging Workshop (all participants invited), 09 April 2008, Perth, AU
- *"Multi-Frequency Synthesis Imaging with Multi-Scale deconvolution"*, Talk at the Second SKA Calibration and Imaging Workshop, 05 December 2006, Cape Town, South Africa
- *"Wide Bandwidth Imaging: Challenges and prospects for the EVLA and beyond"* ,Talk at the URSI National Radio Science Meeting, 06 January 2006, Boulder, USA

### Lectures at Interferometry Schools and Imaging Workshops

- *"Imaging and Deconvolution"*, Summer Student lecture at the NRAO/SOC, 20 June 2013, Socorro, NM, USA.
- *"Wide-band wide-field imaging (sky-domain) + RFI identification and flagging"*, EVLA Data Reduction Workshop, 9 April 2013, Socorro, NM, USA.
- *"Deconvolution and wide-band imaging"*, Third-generation Calibration (3GC3) Interferometry School, 13 February 2013, Port Alfred, South Africa (via Skype from Socorro).
- *"Wideband Imaging"*, CSIRO Astronomy and Space Sciences Radio Astronomy School, 27 September 2012, Narrabri, NSW, Australia.
- *"Imaging and Deconvolution"*, CSIRO Astronomy and Space Sciences Radio Astronomy School, 25 September 2012, Narrabri, NSW, Australia.
- *"Wide Bandwidth Imaging"*, 13<sup>th</sup> NRAO Synthesis Imaging Workshop, 31 May 2012, Socorro, NM, USA.
- *"Wide-band wide-field imaging (sky-domain) + RFI identification and flagging"*, EVLA Data Reduction Workshop, 24 Feb 2012, Socorro, NM, USA.
- *"Wide-field Wide-band Imaging with the EVLA - II"*, EVLA Data Reduction Workshop, 15 September 2011, Socorro, NM, USA
- *"Wideband imaging with the EVLA"*, NRAO Algorithm R&D Group Lecture-series, 21 July 2011, Socorro, USA.

### Student Projects Supervised

- **Summer 2013 + Fall 2013** : Kara Kundert, Undergraduate at Oberlin College, Ohio, USA / University of Michigan, Ann Arbor, USA
- **Summer 2013** : Julia Mayeshiba, Undergraduate at University of Wisconsin, Madison, USA
- **Summer 2011** : Caroline Houston, Undergraduate at Rochester Institute of Technology, NY, USA.

### Committee Service

- NRAO Student Programs Review Committee (2013)

### Education and Public Outreach

- Tour guide for the Very Large Array at open-house events in 2005, 2008, 2010.
- Coached two Science Olympiad teams from the Sarracino Middle School, Socorro, NM (2011, 2014)
- Remotely delivered lecture on *"A radio eye on the universe"* as part of the "Storming Aurora" conference organized by the Astronomy Club at the Birla Institute of Technology and Science, Goa, India, 17th November, 2012.
- Alumni web-lectures as part of the BITS-Embryo project (<http://www.bitsembryo.org>), aimed at introducing undergraduate students at the Birla Institute of Technology and Science, India, to current research and technology trends in various disciplines. (1) *"Remote Sensing At Its Extreme - the interdisciplinary nature of observational radio astronomy"*, BITS-Pilani, Nov 2007 and (2) *"Remote Sensing and Image Making"*, BITS-Goa, Jan 2009.
- An introductory lecture about the working of a radio interferometer, for a group of 16 high-school students who visited the NRAO, Socorro, NM in April 2009.

**Fellowships/Awards/Funding**

- Travel grant from URSI Commission-J towards attending the URSI-GASS in Istanbul, Turkey - Aug 2011
- NRAO Pre-Doctoral (Reber) Research Fellowship Jan 2008 - Dec 2009
- Award for overall best outgoing student, Dept of Physics, BITS, Pilani May 2001

**Technical Schools Attended**

- Ninth Synthesis Imaging Summer School, NRAO, Socorro, June 2004
- Introductory Astrophysics Summer School, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India May 2000 - Jun 2000

**Software Skills**

- Programming languages : C, C++, Python
- Environments : Unix/Linux
- Data Analysis Packages : Matlab/Octave, Scipy/Numpy, CASA, AIPS
- Libraries : GNU Scientific Library, Numerical Recipes, Bayesys, MPI

**Radio Astronomy Observational Projects (past and current)**

The following accepted VLA projects require wideband imaging of Stokes I emission and spectral index, some on single-pointings and some on mosaics. Several require full-stokes wideband imaging to detect weak polarized intensity, and rotation-measure synthesis to map magnetic fields. Some projects use wideband imaging algorithms on low dynamic range and low surface brightness images, requiring high fidelity reconstructions in low signal-to-noise situations. Others require high dynamic-range imaging that combine wideband techniques with time-varying primary-beam correction techniques. I am actively participating in the imaging work for a few of these projects, and play an advisory role in the others.

- VLA/14A-360, " *Resolving the Obscured Cosmic Accretion History and Modes of Galaxy Assembly*", W.Rujopakarn, G.Rieke, R.Iverson, F.Owen, C.Carilli, J.Dunlop, M.Pannella, D.Elbaz, M.Dickinson, N.Miller, D.Alexander, D.Ballantyne, R.Windhorst, B.Robertson, B.Weiner, A.Taylor, K.Bundy, S.Bhatnagar, **U.Rau**, A.Cibinel, K.Nyland, P.Jagannathan, K.Penner
- GBT/14A-252, " *Simultaneous wide-band and spectral-line imaging of the Galactic plane*", D. A.Roshi, S. Bhatnagar, M.Rupen, R.Kothes, **U.Rau**, D.Green, P.Palmer, S.Dougherty, K.Golap
- VLA/13B-091, *Understanding M87 : a multi frequency campaign II*, F.DeGasperin, M.Briggen, E.Churazov, W.Cotton, H.Falcke, W.Forman, H.Intema, A.Merloni, M.Murgia, E.Orru, F.Owen, **U.Rau**
- VLA/13B-041, *A Deep Spectral Index Survey of a subsample from LITTLE THINGS*, G.Kitchener, E.Brinks, V.Heesen, **U.Rau**, M.Rupen, D.Hunter
- VLA/13A-328, 12A/-288, 10A-177 *Star formation and magnetic fields in dwarf galaxies*, V.Heesen, E.Brinks, M.Rupen, **U.Rau**, D.Hunter
- VLA/13A-096, GBT/13A-095, " *Understanding M87: a multi-frequency campaign-I* ", F.DeGasperin, M.Briggen, E.Churazov, W.Cotton, H.Falcke, W.Forman, H.Intema, A.Merloni, M.Murgia, E.Orru, F.Owen, **U.Rau**

- VLA/12B-016, *A Pilot Study of the microJansky Sky*, M.Mao, C.Carilli, **U.Rau**, R.Perley, R.Norris, J.Lovell
- VLA/12A-398, *Magnetic Field Amplification at Shocks in Cassiopeia A*, T.DeLaney, M.Rupen, L.Rudnick, **U.Rau**, S.Bhatnagar, E.Greisen
- GBT/12A-355, “*Simultaneous wide-band and spectral-line mosaic imaging in the Galactic plane*”, A.Roshi, S.Bhatnagar, M.Rupen, R.Kothes, **U.Rau**, D.Green, P.Palmer, S.Dougherty, K.Golap
- VLA/12A-234, *A deep 6cm radio continuum survey of LITTLE THINGS*, E.Brinks, V.Heesen, D.Hunter, M.Rupen, **U.Rau**
- VLA/11B-157, “*Simultaneous wide-band and spectral-line mosaic imaging in the Galactic plane*”, S.Bhatnagar, M.Rupen, R.Kothes, A.Roshi, **U.Rau**, D.Green, P.Palmer, S.Dougherty, K.Golap
- VLA/11B-117, “*Inner Lobes of Cen A: Energy Transport to the ISM and the 500 kpc Radio Source*”, S.Neff, F.Owen, J.Eilek, **U.Rau**, S.Bhatnagar
- VLA/11B-061, *A Complete and Deep Continuum Survey of M31, the Nearest Large Spiral Galaxy*, A.Leroy, R.Beck, S.Bhatnagar, R.Braun, J,Dalcanton, A.Kepley, S.Mao, **U.Rau**, K.Sandstrom, E.Schinnerer, F.Tabatabaei, D.Weisz
- VLA/11A-213, *The GOODS-N Deep Field - First Steps with EVLA*, F.Owen, S.Bhatnagar, **U.Rau**, G.Morrison, M.Pannella, V.Strazzullo, M.Yun,W.Wang, T.Muxlow, R.Iverson, I.Smail, R.Beswick, M.Dickinson,A.Barger, I.Wold
- VLA/10B-173, *Deep Observations of Crowded Stellar Fields*, S.White, M.Rupen, G.Hallinan, T.Bastian, **U.Rau**, R.Osten
- VLA/10A-148, “*A Pilot Project For A Full Polarization Wideband Galactic Plane Survey*”, S.Bhatnagar, D.Green, M.Rupen, R.Perley, **U.Rau**, K.Golap
- VLA/08A-134, *M87: The Impact of a Black Hole on its Environment*, **U.Rau**, F.Owen, J.Eilek, T.Cornwell