

## **Y.S. Rao**

Senior Research Scientist  
Centre of Studies in Resources Engineering (CSRE)  
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### **SUMMARY OF QUALIFICATIONS**

- Experience in processing and analysing passive and active microwave remote sensing data for land based applications.
- Writing research proposals and executing them for various organizations.
- Dissemination of knowledge to students by giving lectures and guiding their projects.
- Familiar with many image processing software, programming languages and system administration on different platforms.

### **EXPERIENCE**

#### **Senior Research Scientist ( From April 2005 - onwards, at CSRE, IIT, Bombay)**

- Received funding for two research projects on “Soil moisture mapping using active and passive microwave remote sensing techniques.” Also Co-investigator of several research projects and contributed extensively for their successful completion. About 6 research papers were published as author/co-author during this period.
- Course material for NR603 and NR610 were prepared and taught the courses.

#### **Research Scientist ( Feb. 1999 - March 2005, at CSRE, IIT, Bombay)**

- Received funding for three research projects on SAR related work and successfully executed. Also Co-investigator of several research projects and contributed extensively for their successful completion. About 15 research papers were published as author/co-author during this period.
- Guided eight student projects in several disciplines.
- Maintaining computer network, systems and web page of our Centre.

#### **Senior Research Assistant ( From 1985 – 1999, at CSRE, IIT, Bombay)**

- Worked in 10 research projects related to active and passive microwave remote sensing. Also worked towards my Ph.D. on “Radiation characteristics of moisture and soil moisture estimation through passive microwave remote sensing.” About 20 papers were published in journals/proceedings during this period as author/co-author. .

#### **Software packages and Programming Skills**

- Image Processing Software : ENVI, ERDAS Imagine, PCI Geomatica, GeoImage.  
InSAR Software : Gamma, Atlantis, DORIS (Delft Univ.), ISAR (ESA),  
RNGCHN(Range change: Displacement components from dislocation).  
Others : JPL SIR-C software, Michigan MIMICS, Gnuplot, MS Office,  
LaTex, etc., Programming knowledge in C, C++, Fortran and HTML on both Unix  
and Windows.

### **Conducting Training Programmes/Workshops/Conferences**

- Many training programmes were conducted for Indians on SAR and InSAR related activities as a member of task group. Also organized international programmes with the help of DLR Germany, CNES France and University of Capetown, South Africa.

### **Teaching Experience**

- Taking classes for trainees of quality improvement programme and also for M.Tech students of Civil Engineering on Microwave Remote Sensing.
- After M.Sc., I taught courses on quantum electronics, electronics, statistical mechanics and laboratory techniques.

### **EDUCATIONAL QUALIFICATIONS**

- Ph.D. - Passive Microwave Remote Sensing of Soil Moisture, Department of Physics, Indian Institute of Technology, Bombay, 1992.  
Pre.Ph.D. – Study of Polymers’ state by Ultrasonics. Andhra University, 1984.  
M.Sc. - Physics with Industrial Electronics Specialisation, Andhra University, 1982.  
B.Sc. - Physics (main) with Maths and Chemistry as ancillaries, Andhra University, 1980.

### **PROFESSIONAL AFFILIATIONS**

Life member of Indian Society of Remote Sensing (ISRS), Indian Society of Geomatics (ISG)

### **LIST OF PUBLICATIONS**

#### **Papers in Journals**

1. Gulab Singh, Kumar V., Venkataraman G, Rao Y.S. and Snehmani, Snow porosity estimation using advanced synthetic aperture radar single look complex data analysis and its effects on backscattering coefficient, J. Applied Remote Sensing, Vol. 1, 013522 (23 July 2007)
2. Rao K.S., Al-Jassar H.K., Phalke S., Rao Y.S., Muller J.P., and Li Z., A study on the applicability of repeat-pass SAR interferometry for generating DEMs over several Indian test sites, 27, 595-616, 2006.
3. K.S.Rao and Y.S. Rao, Advances in microwave remote sensing towards agricultural applications, NNRMS Bulletin, India, No-2, pp. 46-60 Jan. 1997.
4. Rao K.S., Y.S. Rao and J.R. Wang, Frequency dependence of polarization phase difference and polarization index for vegetation covered fields using polarimetric, Int. J. Remote Sensing, Vol. 16, No. 18, pp. 3605-3617, Dec. 1995.
5. Ijjas G. and Y.S. Rao, Microwave Remote Sensing of Soil Moisture from Aircraft in Hungary, Int. J. of Remote Sensing, 13, 471-479, 1992.

#### **Papers in Conferences**

2. Rao, Y.S., A.K. Singh, S. Sharma and G. Venkataraman, ENVISAT ASAR Polarimetric Data for soil moisture mapping, PolInSAR workshop 2007, held at Frascati, Italy, 2007.
3. Rao, Y.S. and Sonika Sharma (2006), Monitoring of flood over Gujarat region using AQUA AMSR-E derived surface soil moisture, SPIE Vol. 6412, 641208 (Dec. 12, 2006)
4. Rao, Y.S., G. Venkataraman and G. Singh (2006), ENVISAT-ASAR data analysis for snow cover mapping over Gangotri region, Proc. SPIE Vol. 6410, 641007 (Dec. 7, 2006)

5. Gulab Singh, Vijay Kumar, Kishor Mohite, G. Venkataraman, Y. S. Rao, and Snehmmani, Snow wetness estimation in Himalayan snow covered regions using ENVISAT-ASAR data, Proc. SPIE Vol. 6410, 641008 (Dec. 9, 2006).
6. Rao, Y.S., S. Sharma, V. Garg and G. Venkataraman (2006), Soil Moisture Mapping over India using Aqua AMSR-E derived Soil Moisture Product, Proc. IGARSS 2006, Denver, CO, USA.
7. V. Kumar, Y.S. Rao, G. Venkataraman, R.N. Sarwade and Snehmmani (2006), Analysis of Aqua AMSR-E derived Snow Water Equivalent over Himalayan Snow Covered Regions, Proc. IGARSS 2006, Denver, CO, USA.
8. Alpna Sharma and Y.S. Rao, Educational Application of BAM, Iran Earthquake and Data Sets from ENVISAT ASAR for InSAR and DInSAR Studies, will be presented in ISRS symposium, to be held at Jaipur during Nov. 3-5, 2004.
9. Rao Y.S., G.Venkataraman, K.S. Rao, and A. Snehmmani, SAR Interferometry for DEM generation and movement of Indian Glaciers, Proc. of IGARSS 2004 symposium, held at Alaska, USA, 2004.
10. Rao Y.S., G. Venkataraman, K.S. Rao, Snehmmani and P. Mathur, Application of Differential SAR Interferometry for the movement of Gangotri and Siachen Glaciers, presented in the International Symposium on Snow Monitoring and Avalanches, held at Manali, India, during 16-16 April, 2004.
11. Navekar P.S., Y.S. Rao, K.S. Rao and G. Venkataraman, Brightness Temperature ( $T_B$ ) Data Analysis from Advanced Microwave Scanning Radiometer (AMSR-E) onboard Aqua Satellite for Snow Cover Mapping, presented in the International Symposium on Snow Monitoring and Avalanches, held at Manali, India, during 16-16 April, 2004
12. Ryan M. and Y.S. Rao, PC Based Raw Data Processor for Interferometric SAR Applications, presented in 1<sup>st</sup> Int. Conference on Microwaves, antenna, propagation and Remote Sensing, held at Jodhpur, India, 15-19 Dec. 2003.
13. Rao Y.S., Comparison of Software for InSAR Applications, presented in Fringe 2003 workshop, held at Frascati, Italy, Dec.1-5, 2003.
14. Rao Y.S. and K.S. Rao, Comparison of DEMs derived from InSAR and IRS-1C optical stereo techniques, presented in Fringe 2003 workshop, held at Frascati, Italy, Dec.1-5, 2003. [http://earth.esa.int/workshops/fringe03/participants/287/paper\\_ysrao\\_comp\\_dems\\_full\\_paper.pdf](http://earth.esa.int/workshops/fringe03/participants/287/paper_ysrao_comp_dems_full_paper.pdf).
15. Rao Y.S. (2003), Comparison of foreign and Indian satellite data distribution systems and requirement for NRSA Viewer, (1993), Proc. 13th User Interaction Meet, NRSA Data Centre, Hyderabad, Feb. 26-27, 2003.
16. Mahato B.C., Ahok Kumar, Y.S. Rao, G. Venkataraman, and A. Snehmmani, SAR Data Analysis for mapping Beaskund Glacier, Proc. of National Symposium on Remote Sensing and GIS, held at CSRE, IIT, Bombay during Dec. 5-7, 2001.
17. Rao K.S., Y.S. Rao, D. Jayanand and Prithviraj, Field Experiments Synchronous with SRTM flights, Proc. IGARSS 2001 held in Sydney, Australia, July 9-13, 2001.
18. Rao, K.S., Y.S. Rao, J. Kannan and B.S. Pani, Application of Remote Sensing for Bhuj Earthquake, Proc. Recent Earthquakes of Chamoli and Bhuj, pp. 217-224, held in Agra, May 24-26, 2001.
19. Rao Y.S., K.S. Rao, G. Venkataraman, Application of SAR Interferometry to Himalayan glaciers for DEM generation and movement studies, Proc. Remote Sensing and Mountain meteorology, held in Manali during Nov. 2000. pp.105-142, 2001.
20. Snehmmani A., P. Mathur ., G. Venkataraman, and Y.S. Rao, SAR data analysis for mapping Beaskund Glacier, Proc. Remote Sensing and Mountain Metereology, held at Manali during Nov. 2000, pp. 133-142, 2001
21. Rao K.S., Y.S. Rao, C. Rama Prabha, G. Venkataraman and M.V. Khire, Differential InSAR Research at IIT Bombay - Simulation Experiments Synchronous with ERS 1/2 Tandem Passes, Proc. of Fringe'99, held at Leige, Belgium, Nov.10-12, 1999. [http://earth.esa.int/pub/ESA\\_DOC/fringe1999/Papers/rao.pdf](http://earth.esa.int/pub/ESA_DOC/fringe1999/Papers/rao.pdf)

22. Rao K.S. and Y.S. Rao, SAR Interferometry for topography and glacier movement, Proc. of National snow science workshop (NSSW) proceedings, workshop was held at Manali during 29-30, Oct. 1999.
23. Rao K.S., Y.S. Rao and R.K. Midha, Indian SAR interferometry research and educational programs, Proc. of 2nd International symposium on Operationalisation of Remote Sensing, held at ITC, Netherlands, August 16 - 20, 1999.  
<http://www.itc.nl/symposia/index.html>
24. Rao K.S. and Y.S. Rao, SAR Interferometry and Glaciology Applications, Proc. of Snow, Ice and Glaciers - A Himalayan Perceptive. symposium held at Lucknow, March 9-11, 1999.
25. Rao Y.S. and K.S. Rao, Comparison of models for soil moisture estimation using SIR-C data, presented in ISPRS symposium held in Nov.24-25, 1997 at Hyderabad, India.
26. Rao, K.S. and Y.S. Rao, Soil moisture estimation using SIR-C data: A case study over Bhavnagar test site, India. Presented in IGARSS'97 symposium, Singapore, August 4-8, 1997.
27. Rao K.S. and Y.S. Rao, Field experiments synchronous with ERS-1 and 2 tandem mission for the simulation of neotectonic movement, Proc. 3rd ERS-1 symposium, held at Florence, 17-20 March, ESA SP-414, Vol. 1, pp. 429-433,1997.
28. Rao Y.S. and K.S. Rao, Decomposition of Stokes matrix of SIR-C data into odd, even and depolarization components, Presented in the Symposium of Indian Society of Remote Sensing, held at Pune, India, December 4-6, 1996.
29. Rao Y.S. and K.S. Rao, Study of vegetation through polarization phase difference using SIR-C data, presented in the Symposium of Indian Society of Remote Sensing, held at Pune, India, December 4-6, 1996.
30. Rao Y.S. and K.S. Rao, Polarimetric signatures of various land features over Gujarat test site using SIR-C data, Proc. of the Indo-US Workshop held at IIT, Bombay, October 6-9, pp. 561-568,1996.
31. Jai S. Sukhatme, V. Walavalkhar, Y.S. Rao, G.Venkataraman, M.V. Khire and K.S. Rao, Development of SAR Interferometry at IIT, Bombay, India, Proc. of IGARSS'96 symposium held at Lincoln, Nebraska, USA, during 27-31 May 1996, Vol. 1, pp.430-433, 1996.
32. Rao K.S., Y.S. Rao, L. Venkataratnam and P.V.N. Rao, Potential of SIR-C data to study vegetation over Gujarat test site, Proc. of IGARSS'96 symposium held at Lincoln, Nebraska, USA, during 27-31 May 1996, Vol. 1, pp.201-203, 1996.
33. Rao Y.S., P.V.N. Rao, L. Venkataratnam and K.S. Rao, ERS-1 and JERS-1 SAR data analysis for soil moisture and vegetation, Proc. of IGARSS'96 symposium held at Lincoln, Nebraska, USA, during 27-31 May 1996, Vol. 1, pp.163-165,
34. K.S Rao and Y.S. Rao, The potential of JERS-1 L-band SAR data to discriminate soil moisture levels and vegetation types, Proc. of Results reporting meeting of JERS-1 system verification program, held in Tokyo during Nov. 29-Dec. 1, 1994, Vol 2. pp.46-54.
35. Rao K.S., Y.S. Rao and G. Ijjas, Soil moisture estimation from multifrequency microwave radiometer data based on statistical inversion technique, Proc.ESA/ NASA International Workshop, held at Saint Lary, France, pp.475- 484, VSP 1994.
36. Rao Y.S., K.S. Rao, M. Jafrullah, B.K. Mohan and M.V. Khire, Combined use of Intera X-band SAR, ERS-1 SAR and IRS-1A data for agricultural applications, Proc. National Symposium on Microwave Remote Sensing and Users'meet, Ahmedabad, India, pp. 161-166, Jan. 1994.
37. Rao K.S., Y.S. Rao and M.V. Khire, Polarimetric AIRSAR data analysis for soil moisture mapping, Presented in the Symposium of Indian Society of society of Remote Sensing, Nov. 25-27, 1993, Guwahati, India.

38. Ijjas G., Y.S. Rao, F. Horcher, Z. Vargai and L. Aujeszky, Soil moisture estimation using truck-mounted L-, S-, and thermal-infrared radiometers and different theoretical models, Proc. 11 th EARSeL Symposium, July 1991, pp. 216-223.
39. Rao K.S., Suresh Raju and Y.S. Rao, Model for the retrieval of soil moisture and surface roughness parameters from multifrequency backscattering coefficients, Proc. of IGARSS '91, symposium, Espoo, Finland, 397-400, 1991.
40. Ijjas G., K.S. Rao and Y.S. Rao, Efficiency of 1.4 and 2.7 GHz radiometers data for the retrieval of soil moisture profile, Proc. of IGARSS symposium held at Espoo, Finland during June 3-6, 1991, 765-768, 1991.
41. Rao K.S, P.V.N. Rao, Y.S. Rao, Girish Chandra, C.S. Raju and M.V. Bapat, A study on the effect of soil texture on passive microwave remote sensing, J. of Indian Society of Remote Sensing, 16, 55-63, 1988.

**LIST OF SPONSORED PROJECTS (worked as Principal Investigator , Co-principal investigator and Senior Research Assistant (SRA))**

1. Multifrequency model for soil moisture estimation using microwave remote sensing technique, Sponsored by DST, 1985-89. (SRA)
2. Optimisation of microwave sensor parameters for soil moisture studies, Sponsored by DST, 1989-93. (SRA)
3. Airborne SAR data for natural resources in Godavari & Andamann areas, sponsored by DST, 1989-94. (SRA)
4. JERS-1 SAR verification project on "Agriculture applications-Cultivated land monitoring", NASDA, Japan, 1992-94. (SRA)
5. Monitoring of soil moisture through ERS-1 SAR data, DST, 1993-96. (SRA)
6. Ground truth data collection synchronous with U.S. Space Shuttle SIR-C passes, DST, 1994-95. (SRA)
7. SIR-C data processing and applications, DST, 1996-98. (SRA)
8. SAR Interferometry to study the active topography and deformation in the India-Eurasia Collision zone, University of California, Davis, Collaboration project, 1997-98 (SRA)
9. SAR Interferometry for topography and Earth Crust Movement, ISRO-IITB Cell, 1995-2000. (SRA)
10. Estimation of millimeter movements of corner reflectors using ERS-1/2 tandem data: Differential SAR Interferometry, ESRIN/ESA, Italy, 1998-2002 (SRA)
11. Land-based applications of ENVISAT ASAR data - SAR Interferometry and Soil Moisture, ESRIN/ESA, (Co-PI)
12. Field experiments and ground-truth data synchronous with ERS passes - Development of database of ERS SAR SLC for Interferometry, 1999-2000. (Co-PI)
13. SRTM-Project and Field data collection, DST, 1999-2000 (Co-PI)
14. Three Training programs on SAR Interferometry, DST, 1999-2000. (Co-PI)
15. Research and Advanced Training in SAR Interferometry, DST, 1999. (Co-PI)
16. Snow characterisation using Microwave Remote sensing, DST, 2000-2003. (Co-PI)
17. Comparison of optical and SAR DEMs and their Fusion, ISRO-IITB Cell, 2002-2003. (PI)
18. ENVISAT ASAR data analysis for snow and glacier monitoring, DST-SASE, Jan 2004 – June 2004. (PI)
19. Monitoring landslides and land deformation using differential SAR Interferometry, MHRD, 2001 – 2004.
20. Soil moisture mapping using active and passive microwave remote sensing techniques, 2005-2006, ISRO-IITB sponsored.

## **GUIDANCE TO STUDENT'S PROJECTS**

### **M.Tech. Projects :**

1. Application of SAR Interferometry and GPS to DEM Generation and Evaluation, Mr. Phani Kumar, Dept. of Civil Engg., IIT, Bombay, 2001.
2. Generation and Validation of DEM using PAN stereo data, ERS tandem data and GPS data, Mr. Venkata Venkataramana, Dept. of Civil Engg., IIT, Bombay, 2003.
3. ENVISAT ASAR data analysis for snow and glacier mapping, Mr. Chandrakant Sonare, Baraktullah University, Bhopal, 2004
4. SAR Interferometry Data for DEM Generation and Displacement Studies, Mr. Sachin Kumar Kanere, Baraktullah University, Bhopal, 2004.
5. Soil moisture estimation using active and passive microwave remote sensing techniques, Indian Institute of Remote Sensing, Dehradun, 2006.

### **B.E. Projects :**

1. Development of a viewer for Indian Remote Sensing Satellite (IRS) data products, Ms. D. Swarna Latha, MCA student, Bharathidasan University, April 2002.
2. Digital Image processing of optical and radar data from satellites, Ms. Bharti Kadam, Ms. Prithy Pillai and Ms. Shomi Sugathan, B.E. Final Year, Amrutavahini College of Engineering, Sangamner, June 2002
3. Synthetic Aperture Radar Signal Processing for Various Data Products, Royyuru Chaitanya, Ritech Venkateshwaran, Ryan Mascarenhas, Manik Trivedi, B.E. Final Year students, Sardar Patel College, Mumbai, April 2003
4. Development of Interferometric Synthetic Aperture Radar Processor for Digital Elevation Model Generation, Aliasghar Bawa, Harish Sundaram, Vishal Saraf and Mithun Hodar, B.E. Final Year students, Sardar Patel College, Mumbai, April 2003
5. Computer processing of Remote Sensing Data and Automatic Registration of Images, Ms. Sandya Rajagopalan, Ms. Savant Ruchira, Ms. Shilpa Tanguturi and Ms. Jinal Shah, B.E. Final Year students, April 2004.
6. Polarimetric SAR data processing for classification Land feature, B.E. Final year students, Raghu Ch., Harshit E. and Heamant E., SIES Nerul, Dept. Electronics Telecommunication.

### **Summer Projects :**

1. Development of software in Visual C++ for Computer Display of IRS and Radar data, Mr. Hemant Bhanawat, 3<sup>rd</sup> year B.E. student, Jodhpur, July 2000.
1. 3D visualization of satellite images using Chroma depth glasses, Mr. Chrantan Bhabhara, 3<sup>rd</sup> year B.E. student, Jodhpur, July 2000.
2. Interferometric Synthetic Aperture Radar Image Data for Earthquake Applications, Ms. Alpana Sharma, 3<sup>rd</sup> Year, Dept. of Civil Engg., IIT, Roorke, July 2004.
3. Synthetic Aperture Radar Signal Processing for Image Generation, Mr. Lalit Kumar Begani, 3<sup>rd</sup> Year, Dept. of Electronics and Communication, National Institute of Technology, Karnata, Surathkat – 575 025., July 2004.
4. Decoding of Remote Sensing Header Data of Different Satellite Products, Indira Priyadarshini, 3<sup>rd</sup> Year, Dept. of Computer Science and Engg., Nalanda Institute of Engineering and Technology, Vijayawada, Apr., July 2004.