Kalpesh R. Patil

Research Scholar, Civil engineering department,
Indian Institute of Technology, Bombay, India.

A research enthusiast highly motivated and interested in application of various artificial intelligence and optimization methods to solve real world forecasting problems.

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Expertise

Ocean observations and data analysis
Swarm intelligence methods
Machine learning
Genetic programming
Matlab
Time series modelling
Genetic and Evolutionary Algorithms

Education

PhD
IIT Bombay, India.
Since Jan-2014

Thesis: Real time prediction of sea surface temperatures in North Indian Ocean using artificial neural networks
Supervisor: Prof. M. C. Deo
Brief Synopsis of Research: Artificial neural network (ANN) models were developed to predict real time sea surface temperature (SST) over northern Indian Ocean using satellite re-analysis data. At each node of satellite data ANN models were calibrated to perform multi lead time SST predictions like univariate time series models. Such predictions then interpolated to make basin-scale SST predictions. ANN models include trivial feed forward and advanced wavelet neural networks.
A detailed synopsis is attached at the end in appendix section.

M. Tech
IIT Bombay, India.
(Water resources Engineering)
Aug-2010 to Jun-2012

Thesis: Prediction of SST using non-linear auto-regressive neural network
Supervisor: Prof. M. C. Deo
Courses Included: Statistics and Probability, Stochastic hydrology, Numerical techniques in Hydraulic engg., Finite element analysis, Ground water hydrology, Water resources engineering

B. Tech, College of Engg. Pune, India.
(Civil Engineering)
Aug-2003 to Jun-2007

Thesis: Design of sewage treatment plant at Baner, Pune City, India.
Courses Included: Strength of materials, Theory of structures,
Fluid mechanics, Water and wastewater treatment, Engineering mathematics.

Employment

Research Associate
IIT Bombay, India.
Aug-2013 to Dec-2014

Role: Use of various artificial intelligence methods to predict SST at specific locations in Indian Ocean. Carry out experimentation with all possible parameters of popular AI methods and develop a generic SST prediction algorithm for a specific location which later can be used at any location.

Assistant Professor
B. R. Harne college of Engg.,
Mumbai University, India.
Aug-2012 to Jul-2013

Role: Teaching and conducting lab experiments of courses Strength of materials and Fluid mechanics for under graduate students. Reviewing examination papers at University level of civil engineering courses. Also acted as an active member in department library management and conducting and arranging workshops on efficient teaching.

Senior Software Engineer
Satyam Comp. Services Ltd., Bangalore, India.
Jan-2008 to Mar-2009

Role: Develop mobile applications for Nokia mobiles based on Symbian series 40/60 operating systems. Such application includes Optical character recognition and Advanced meeting scheduler.

◆ Other Research projects ◆

Cat Swarm Optimization Toolbox in Matlab
Jan 2018 – Mar 2018

Optimizes ANN weights using cat swarm intelligence method. Generic in nature and can be applied to any function. If needed can also work as Particle swarm methods.

Wave height forecasting using ANN
Aug 2017 – Dec 2017

Significant wave height (Hs) forecasting at Ratnagiri off India's west coast. ANN models were developed for Hs forecasting at 12, 24 and 48 hours. An extensive analysis of autocorrelation function made to provide important inputs to ANN model.

Precipitation modelling with Temperature and Vapor Pressure using ANN
Apr 2017 – Nov 2017

Use cause effect models to forecast daily precipitation using Vapor pressure and air temperature and its comparison with times series precipitation models.

Noise level prediction from number of vehicles using ANN
Feb 2017 – Apr 2017

Forecasting noise level at a signal using number of vehicles. Traffic was of mainly three types Industrial, commercial and residential. Both separate and combined models were developed, but combined models suggested a least impact of type of traffic on performance of model.

Damage Identification in Structure using ANN
May 2014 – Jul 2014

Estimation of crack width in structural elements from stress, strain and various forces existing on structure.

Merging various satellite SST data products
Feb 2014 – Mar 2014

Satellite SST products are merged from sources of infrared, microwave and thermal bands to arrive at better product which has better accuracy and high availability

◆ Professional courses attended ◆

- 'Emerging trends in ocean observations and ocean data analysis' fifteen days workshop at INCOIS, Hyderabad, India.
- 'Short term course on Data Assimilation' by Prof. S. Laxmivarahan at IIT Bombay
- 'Time Series Analysis' by Prof. S. Laxmivarahan at IIT Bombay

◆ Conferences and workshop ◆

- OTO'18, OCEANS'18 MTS/IEEE Kobe/Techno-Ocean *2018* — Kobe, Japan.
- 22nd, International conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (*HYDRO 2017*) — L D College of Engg. Ahmedabad, India.
- 19th International conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (*HYDRO 2014*) — MANIT, Bhopal, India.
- National workshop on Dam rehabilitation Trends and practices — CWPRS, Pune, India.
- Coastal Vulnerability to Climate Change — IIT Bombay

Responsibilities

- Active reviewer for '*ISH Journal of Hydraulic Engineering*'

Publications/Conference Papers

- **Peer reviewed journals**

  Patil, K., & Deo, M. C. (2018). Basin-Scale Prediction of Sea Surface Temperature with Artificial Neural Networks. *Journal of Atmospheric and Oceanic Technology*, *35*(7), 1441-1455.

  Patil, K., & Deo, M. C. (2017). Prediction of daily sea surface temperature using efficient neural networks. *Ocean Dynamics*, *67*(3-4), 357-368.

  Patil, K., Deo, M. C., and Ravichandran, M. (2016). Prediction of sea surface temperature by combining numerical and neural techniques. *Journal of Atmospheric and Oceanic Technology*, *33*(8), 1715-1726.

  Patil, K., Deo, M. C., Ghosh, S., & Ravichandran, M. (2013). Predicting sea surface temperatures in the North Indian Ocean with nonlinear autoregressive neural networks. *International Journal of Oceanography*, *2013*.

- **Conferences**

  Patil K, and Deo M. C. (2018). Basin-scale Prediction of Sea Surface Temperature with Artificial Neural Networks. 23rd, *International conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (HYDRO 2018)*, Abstract accepted.

  Patil K, and Deo M. C. (2018). Basin-scale Prediction of Sea Surface Temperature with Artificial Neural Networks. OCEANS'18 MTS/IEEE Kobe / Techno-Ocean 2018, Kobe, Japan

  Patil K, and Deo, M. C. (2017). Real Time Prediction of Sea Surface Temperature with Soft and Hard Computing. 22nd, *International conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (HYDRO 2017)*, 1526 – 1536.

  Patil, K. R., Deo, M. C., and Ravichandran, M. (2014). Neural Networks to Predict Sea Surface Temperature. *19th International conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (HYDRO 2014)*, 1317 – 1326.

Computational skills

- Matlab – Proficient
- R – Beginner
- Fortran – Beginner

Professional Memberships

- Student member of *Indian Society of Hydraulics*

Interests

I enjoy watching Sci-Fi movies and making short films. I have acted as a script writer for two of the short films which won 1st prize at college festival. I also enjoy cooking Indian food.

References

Prof. M. C. Deo (PhD supervisor)
Department of Civil Engineering,
IIT Bombay, India
Email: *mcdeo@civil.iitb.ac.in*

Prof. R. B. Sunoj
Department of Chemistry,
IIT Bombay, India
Email: *sunoj@chem.iitb.ac.in*

I hereby declare that all the information furnished here is true to the best of my knowledge and belief.

Yours Sincerely,

Kalpesh R Patil

APPENDIX

Synopsis of PhD

The roadmap of research is as follows. Primarily we have investigated the accuracy of SST prediction for few existing numerical models. When compared to in-situ data such models found to be under performing at many regions of Indian Ocean. To answer this firstly we have planned to develop a data driven models to correct existing SST forecasts of numerical models and secondly develop individual data driven models to make SST forecasts. Later individual data driven models were employed over a large sea basin belonging to northern part of Indian Ocean (30°N-30°S, 30°E-120°E). Such data driven models were found to be comparable in prediction skill those of numerical models as well as give a prior warning for some critical oceanic events such as Indian ocean dipole, unusual cooling or warming of sea basin and heavy precipitation.

Most of the methods of SST predictions includes physics based numerical models. These model solves the governing equations for a specified boundary conditions and driven by forcing. Such assumptions make them complex for analysis and data exhaustive in applications. And it is rather more difficult to tune these models for a specific parameter of interest such as SST. Moreover such models need a bias correction or downscaling before actual use for a smaller region of interest. Apart from numerical models other solutions to SST prediction do exist, which are statistical methods. Some researchers have explored use of such methods for SST predictions over sea basin. But statistical methods lacked in capturing the spatial variation.

While previous methods are promising but they are either very complex in nature or underperforming. Recently use of artificial intelligence methods is widely seen in modelling of various atmospheric, hydrologic and oceanic parameters. Main advantage of artificial intelligence methods is that, it involves least assumptions, easy to model and also provides workable to accurate solutions.

We have developed data driven ANN models at each node of satellite re-analysis data to make real time SST forecasts at monthly, weekly and daily time scale for multi lead time. Separate ANN models were developed for each multi lead time forecasts. After calibration at each node the SST forecast can be clubbed to together by interpolation to make basin scale SST forecasts.

We have examined that such method of SST predictions does not need any downscaling as they developed for each node of satellite data. Also this method needs less amount of data for calibration as only SST past records are required. Apart from that we have compared our results with few existing numerical models and found that such method is equally performing with numerical model not involving data assimilation. It was also noticed that ANN data driven models captured important ocean events with sufficient lead time. Such events includes heavy precipitation, unusual cooling/warming of ocean, cyclone intensification/dissipation and important weather index like Indian Ocean dipole.

These ANN driven models for SST forecasts can further be strengthened and can be made more accurate if combined with advanced optimization methods such as genetic algorithm, swarm intelligence techniques to generalize the weights and parameters of ANN. Also such ANN models are easy to club with existing data assimilation procedures.

This study does not question the need of conventional numerical models, but proposes a different approach is necessary to study as it is compelling, less complex, faster and provides an effective alternative if explored.