# Abhishek Srivastava

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Google Scholar: Abhishek Srivastava          Reviewer Profile: Publons

## RESEARCH INTEREST

Medical Image Analysis, Document Analysis, Facial Hallucination, Zero-shot learning, Machine Learning.

## EDUCATION

**Jaypee Institute of Information Technology**                                    **Noida, India**
*B Tech. with Honours In Computer Science and Engineering*                  *June 2017 - July 2021*
CGPA: 8.6/10

## WORK EXPERIENCE

**Machine and Hybrid Intelligence Lab, Northwestern University**              **Chicago, IL**
*Post Baccalaureate Research Fellow*                                        *June 2022 - Present*
Responsible for a) implementing and designing computer vision algorithms tailored to segment organs at risk. b) subsequent dose prediction to facilitate radiation therapy. c) Researching paradigms for more robust and accurate uncertainty for deep learning-based medical image analysis tools. d) Designing a robust out-of-distribution toolkit for handling medical imaging data from different institutions and modalities.

**Computer Vision and Pattern Recognition Unit, Indian Statistical Institute**     **Kolkata, India**
*Project Linked Personnel*                                                *September 2021 - May 2022*
Resumed my previous responsibilities at CVPR Unit, ISI Kolkata. Additionally, was responsible for developing a remote vital estimation system, capable of measuring vitals like heart rate and oxygen level from videos recorded by smartphones. The project was funded by Babysensor, Norway.

**Computer Vision and Pattern Recognition Unit, Indian Statistical Institute**     **Kolkata, India**
*Computer Vision Research Intern*                                          *May 2020 - September 2021*
Worked under the joint supervision of Dr. Umapada Pal and Dr. Sukalpa Chanda. Since joining the CVPR Unit, ISI Kolkata, I worked on several distinct computer vision tasks. My work in Medical Image segmentation, text-independent writer identification and face hallucination has resulted in several journal and conference papers. I have frequently collaborated with teams from SimulaMet, University of Oxford, UiT The Arctic University of Norway, Østfold University College during my tenure at ISI.

**Indian Institute of Information Technology**                                **Allahabad, India**
*Research Intern*                                                          *May 2020 - June 2020*
Worked on 'Channel Selection on EEG data' as my research topic. Devised a strategy to quantify importance of each electrode which gathers EEG data from a patient, by identifying the electrodes most informative in predicting epileptic seizures, redundant electrodes can be eliminated which alleviates the cost of EEG data collection.
**Areas worked on:** Medical Imaging, Document Analysis, EEG Signal analysis, Facial Super-resolution, Face recognition, Pose Transfer, Segmentation

## KEY SKILLS

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| **Programming Language** | Python, C++, Java |
| **Deep Learning Frameworks** | Tensorflow, Keras, Pytorch |

# PUBLICATIONS

- **Abhishek Srivastava**, Debesh Jha, Sukalpa Chanda, Umapada Pal, Håvard D. Johansen, Dag Johansen, Michael A. Riegler, Sharib Ali, Pål Halvorsen *"MSRF-Net: A Multi-Scale Residual Fusion Network for Biomedical Image Segmentation"*, IEEE Journal of Biomedical and Health Informatics, 26(5), 2252-2263, 2021.
- **Abhishek Srivastava**, Sukalpa Chanda, Umapada Pal *"Exploiting Multi-Scale Fusion, Spatial Attention and Patch Interaction Techniques for Text-Independent Writer Identification"*, Asian Conference on Pattern Recognition. Springer, Cham, 2022
- **Abhishek Srivastava**, Sukalpa Chanda, Debesh Jha, Michael A. Riegler, Pål Halvorsen, Dag Johansen, Umapada Pal *"PAANet: Progressive Alternating Attention for Automatic Medical Image Segmentation"*, 2021 4th International Conference on Bio-Engineering for Smart Technologies (BioSMART). IEEE, 2021..
- **Abhishek Srivastava**, Sukalpa Chanda, Umapada Pal *"Attribute Guided Attention Generative Adversarial Network with U-Net for Face Hallucination"*, Image and Vision Computing (2022): 104534
- **Abhishek Srivastava**, Sukalpa Chanda, Debesh Jha, Umapada Pal, Sharib Ali *"GMSRF-Net: An improved generalizability with global multi-scale residual fusion network for polyp segmentation"*. accepted in the 26th International Conference on Pattern Recognition (ICPR 2022).
- **Abhishek Srivastava**, Nikhil Kumar Tomar, Ulas Bagci, Debesh Jha *"Video Capsule Endoscopy Classification using Focal Modulation Guided Convolutional Neural Network"*. accepted in IEEE 35th International Symposium on Computer Based Medical Systems.
- Nikhil Kumar Tomar, **Abhishek Srivastava**, Ulas Bagci, Debesh Jha *"Automatic Polyp Segmentation with Multiple Kernel Dilated Convolution Network"*, 2022 IEEE 35th International Symposium on Computer-Based Medical Systems (CBMS). IEEE, 2022.
- **Abhishek Srivastava**, Debesh Jha, Elif Keles, Bulent Aydogan, Mohamed Abazeed, Ulas Bagci *"An Efficient Multi-Scale Fusion Network for 3D Organ at Risk (OAR) Segmentation"*, 2022 IEEE 35th International Symposium on Computer-Based Medical Systems (CBMS). IEEE, 2022.
- **Abhishek Srivastava**, Nikhil Sharma, Shivansh Gupta, Satish Chandra *"Residual Dense U-Net for segmentation of lung CT Images infected with Covid-19"*. accepted at Springer International Advanced Computing Conference, 1367,17-30, 2021.
- Sukalpa Chanda, **Abhishek Srivastava**, Dipanjan Chatterjee, Sourajit Basak, Alain Rakotomamonjy, Umapada Pal, Lambert Schomaker *"Text-Independent Writer Identification for Bengali Script with Limited Training Samples"*. Under Review, International Journal on Document Analysis and Recognition (IJDAR)
- **Abhishek Srivastava**, Debesh Jha, Ulas Bagci *"Comparing Multi-Scale Fusion Methodologies for Head and Neck Tumor Segmentation"*. Under Review, 3rd MICCAI workshop on Head and Neck Tumor Segmentation and Outcome prediction in PET/CT images

# REVIEWER EXPERIENCE

- IEEE Transaction on Medical Imaging.
- IEEE Journal of Biomedical and Health Informatics.

# RESEARCH EXPERIENCE

### "MSRF-Net: A Multi-Scale Residual Fusion Network for Biomedical Image Segmentation"

- In this paper, we proposed a novel architecture called MSRF-Net, which was specially designed for medical image segmentation tasks.
- The proposed MSRF-Net is able to exchange multi-scale features of varying receptive fields using a dual-scale dense fusion block (DSDF) which exchanges information rigorously across two different

resolution scales, and our MSRF sub-network uses multiple DSDF blocks in sequence to perform multi-scale fusion.

○ MSRF-Net advances the performance on four publicly available datasets and is currently the state-of-the-art architecture on each dataset, additionally, MSRF-Net is more generalizable as compared to other state-of-the-art methods.

**"Exploiting Multi-Scale Fusion, Spatial Attention and Patch Interaction Techniques for Text-Independent Writer Identification"**

○ In this paper, three different deep learning techniques - spatial attention mechanism, multi-scale feature fusion and patch-based CNN were proposed to effectively capture the difference between each writer's handwriting.

○ Our methods are based on the hypothesis that handwritten text images have specific spatial regions which are more unique to a writer's style, multi-scale features propagate characteristic features with respect to individual writers and patch-based features give more general and robust representations that help to discriminate handwriting from different writers.

○ The proposed methods outperform various state-of-the-art methodologies on word-level and page-level writer identification methods on three publicly available datasets - CVL, Firemaker, CERUG-EN datasets.

**"GMSRF-Net: An improved generalizability with global multi-scale residual fusion network for polyp segmentation"**

○ In this paper, we address one of the most significant drawbacks in the current line of architectures for medical image segmentation, where a significant performance drop incurred when testing modality or protocol differs from the training distribution.

○ Our GMSRF-Net maintains high-resolution representations while performing multi-scale fusion operations for all resolution scales. To further leverage scale information, we design cross multi-scale attention (CMSA) and multi-scale feature selection (MSFS) modules within the GMSRF-Net.

○ Experiments conducted on two different polyp segmentation datasets show that our proposed GMSRF-Net outperforms the previous top-performing state-of-the-art method by 8.34% and 10.31% on unseen CVC-ClinicDB and unseen Kvasir-SEG, in terms of dice coefficient.

**"AGA-GAN: Attribute Guided Attention Generative Adversarial Network with U-Net for Face Hallucination"**

○ In this paper, we proposed an Attribute Guided Attention Generative Adversarial Network which employs novel attribute guided attention (AGA) modules to identify and focus the generation process on various facial features in the image.

○ Stacking multiple AGA modules enabled the recovery of both high- and low-level facial structures.

○ Extensive comparisons with recent state-of-the-art facial hallucination methods demonstrated the superiority of our technique.

**"PAA-Net: Progressive Alternating Attention for Automatic Medical Image Segmentation"**

○ In this paper, we proposed a progressive alternating attention network (PAA-Net). We developed progressive alternating attention dense (PAAD) blocks, which constructed a guiding attention map (GAM) after every convolutional layer in the dense blocks using features from all scales.

○ The GAM allows the following layers in the dense blocks to focus on the spatial locations relevant to the target region. Every alternate PAAD block inverts the GAM to generate a reverse attention map which guides ensuing layers to extract boundary and edge-related information, refining the segmentation process.

○ Our experiments done on three different biomedical image segmentation datasets exhibited that our PAA-Net achieves favorable performance when compared to other state-of-the-art methods.

**"Residual Dense U-Net for Segmentation of Lung CT Images Infected with Covid-19"**

○ In this paper, a deep learning-based U-Net architecture was proposed as a framework for automated

segmentation of multiple suspicious regions in a CT scan of Covid-19 patient.

- Advantage of Dense Residual Connections was taken to learn the global hierarchical features from all convolution's layers.
- The proposed method achieved an accurate and rapid segmentation with 97.2%, 99.1% and 99.3% as dice score, sensitivity and specificity respectively on Covid infected CT scans.

**"Text-Independent Writer Identification for Bengali Script with Limited Training Samples"**

- In this paper, We investigated writer identification problem on an Indic script (Bengali), when a limited amount of data is considered per writer. Two different features (chain-code histogram and gradient) were combined here to obtain better accuracy.
- Extensive comparisons with several state-of-the-art deep learning-based writer identification techniques has revealed the superiority of our feature based method.
- We obtained an overall accuracy of 87.45% when considering 303 writers in our experiments with only 53 words per writer for training.

**"Remote Heart rate detection and vitals monitoring"**

- Currently working on developing a system capable of registering the heart rate and other vitals like oxygen level remotely using videos captured using webcam or phone cameras.
- The current pipeline involves detecting and extracting landmarks from facial frames and extracting the green channel from the region of interest. Then, Fast Fourier Transform algorithm is performed on the data and the subsequent transformed data is used by a 1-D CNN model for predicting the heart rate.
- The application we developed works on recorded videos, live video feed from webcam as well as mobile cameras. At this point, I am working on developing an additional pipeline to simultaneously measure oxygen levels and heart rate.
- The project is funded by the company babysensor who are planning the global release of the product by the summer of 2022.

**"EEG Channel Selection using Student-Teacher based Knowledge Distillation Techniques"**

- Devised a student teacher based strategy for selection of electrodes collecting EEG data most instrumental towards prediction of seizures.
- The student teacher based technique involved training the teacher and succesively training the student to replicate the latent dimensions encoded by the teacher. The student was designed to be devoid of inter-channel convolutions, enabling us to measure the contribution of each channel.
- We were able to predict epileptic seizures even when we used 50% or 30% of the channels, saving energy and resources previously deemed essential.

**"Pose Guided Person Image Generation"**

- Developed a generative adversarial network which will transfer the pose of a given person to a target pose using the target pose heat map, source pose heat map, and a condition image.
- Implemented several state-of-the art methods, and conducted several experiments to improve upon the existing benchmarks.
- Notable methods were, cyclic GAN which translated image to pose to image. Supervised by both pose heatmaps and ground truth, enabling a stable progressive generation technique.

## Other Achievements

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| 2013 | India State Level Basketball Silver Medalist |
| 2015 | India State Level Basketball Team Member |
| 2016 | Member of School Cabinet |
| 2016 | ISC School Topper |
| 2018 | Instructor of JAVA at IEEE workshop |