Journal of Theoretical and Applied Information Technology
15th March 2023. Vol.101. No 5

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

PREDICTION OF AUTO-DETECTION FOR TRACKING OF SUB-NANO SCALE PARTICLE IN 2D AND 3D USING SVM-BASED DEEP LEARNING

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ABSTRACT

The time series position with large video files that requires conversion based powerful biophysical tools with particle tracking i.e., data analysis the species on interest with traces. The particle tracking that obtained accuracy that demonstrate with Nano scale tracking particle based on the method deep learning. The method current tracking, bright object identify based on input parameter with set limited, heterogeneity spatiotemporal spectrum that handle ill-equipped and biological environment complex with submicron species can present typical poor ratio signal-to-noise. Method execute tracking and optimize which frequently necessary with the involvement of user extensive, the user bias was introduces,which was not inefficient. Method to develop automated tracking, data image from localization particle based on support vector machine that has been developed, method tracking fully automated, 6000 parameter comprising, and video conditions diverse portfolio to train the network that is used with technique deep learning. Accuracy and automation unprecedented has been provided with track of support vector machine, 2D and 3D video simulated with rates false negative and positive low exceptionally and species difficult-to-track video 2D experimental video.

Keywords: *Particle Tracking, Deep Learning, Support Vector Machine, Bio-Imaging, Quantitative Biology.*

1 INTRODUCTION

The environmental surrounding with structure properties and mechanical within cell transport about species from the critical information that can reveal the video microscopic that recorded species that ensemble the tracking high-fidelity with the experiments tracking particles. Physiological barriers across pathogens penetration measure with real-time used extensively based particle tracking [1, 2] drug delivery Trans mucosal system developed facilitate [3, 4], the nucleus of living cells DNA chromosomal domains of organization and dynamics has been explore [5, 6] and engineered probes was based on fluids complex of rheology meso-scale and micro scale characterize [7]. Tracking fully-automated the goal towards the progress significant, and the video that process automatically available with current methods, parameter adjustable is predefined by these methods (8). The raw video of with individual traces with the extraction is divided into two

steps (i) the video has each frame with particle centre that precise located with identical, (ii) path or trace of frame sequential across particle centres the linking. Tracking problem particles with portion linking that can be focused with tracking particle based on previous method. On localization that has been with less program, because the most crucial linking with view prevailing, the false positive with size of fraction that may contain with may localization with large set positive true to pick correctly which have the potential. Instead of linking the localization that we focused primarily, with the paper. An algorithm was presented for tracking of particles, algorithm that used for the construction is the neutral network localization and which is also known as linking algorithm, they implement most common with slight modification in the localization.

Accuracy and automation were the methods in the primary modernity. The video process automatically that can develop with the tracking method with many particle, heterogeneity spatiotemporal that contain the video that present. The ratio signal to noise in low or photo bleaching intercity background, video condition each set optimized must be given method used parameters, ground truth absence highly subjective. User guidance's substantial required and consuming time is optimization parameter. Furthermore, the video experimental that when they applied, the ground truth which is absence is subjective highly. SVT the video experimental that we applied, the trace phantom remove that needed frequently with input. Tracking particle supervised facilitate the characteristic better perhaps the current software the full automation that provided instead, costly, and time-consuming human interaction requiring substantial. The highly variable result with most important, input video sample.

The experimental condition specific tracking method optimizing with various major, to obtain labour intensive and high subjective. The value parameter tune based on video experimental based on applying method tracking has been approach by hand. A range video is error across the assessment qualitatively. Subjective and laborious has been procedure. The optimization quantitative has been used with better approach-conditions experimental observed, possible as closely that match the ground truth. Simulated video that has been applied with those condition which is suitable based on the method for the given tracking, and the assessed quantitative is the error. Tracking error by quantifying, the number of video with large with tracking error that minimize optimized systematically with tracking method parameter. The data simulation on optimized that have been with the parameter, the video experimental that analyse ensure trace removing or adding.

The condition each video with optimize parameter with need to overcome, the next logical step methodology that can be aforementioned. Microscopy conditions specific which instead optimizing, tracking experiment with particle that encounter variations potential encountered wide spectrum the encountered the simulation with large portfolio that we compile. As possible with few parameter designed the existing method, it can be use simple software that make, and conditions microscopy that specific with single parameters set, the objects of interest identifies that can be founded. With thousands of parameter an algorithm construct with approach alternative, and in the portfolio represented conditions under all well perform algorithm optimize with deep learning. Here, imaging framework neural network existing that has been adapt, known as alternative neutral network, identification particle that have to challenge.

ANN in computer vision object recognition that has been become the state-of-the-art, task image many with other methods outperforming (9). Network of connection layer in process information designed Support vector machine feed-forward with ANN. For accuracy most critical sometimes viewed particle tracking with stage linking. Particle identification an approach developed, the strategies linking simple particle using assignment linear is adaptive (10). Method existing several over improvement substantial with our method that rigorously accuracy was tested. For automation for particular, algorithm particle tracking critical component identification particle is suggested.

The tracking particle deep learning that is apply has been beginning with research number of group (11), image measurement statistical making filter banks that serve as a set which is essential. A SVM with input has been used these feature. The trained number of

parameter reduce substantially feature handcrafted has been used.

End to end trained network out developed with in contrast, the data image is the raw input, in every pixel the background versus particle classify the probabilistic with output. The location predict particle has been observed the past and future that can determined the network. The particle localization tunable parameter over 6000 parameter that can be comprised with three-layer has been constructed with SVM. Deep learning techniques has been used for the optimisation with tunable parameter with neutral network, the localization parameter is adjusted the user need to stay that their never with any parameter for localization. The user supervision without wide range condition that can be perform under the optimised network which has result highly. To demonstrate accuracy, wide range conditions were taken with span of challenging video on large set of NN tracker work that we tested in the accuracy demonstration.

2 LITERATURE SURVEY

Xun Cao et, al., (2011)[17] this paper is based on 3D experience a efficient path on converting 2d video into 3d.the future entertainment is bumpy which is poised in 3D experience. The rapid growth in 3D industry impedes of 3D contest is a lack in the display device 3D which is available despites. 3D multi-media experience the efficient path in 3D content that convert 2D with approach in present and quality affect the key element based on creation processes that discuss in 3D content.

Junyuan Xie et, al., (2016) [18] this paper is based on the deep convolutional networks with automatic video convention from 2D to 3 D. rapid growth of 3D demand with the market emerge with virtual reality and mainstream becomes 3D movie. Remaining challenge can produce 3D video. Here, 3D format image is stereoscopic and 2D video which has been converted automatically through deep neutral network. Supervision depth map ground the truth need and stage has been separated. Existing 3D movie from the pairs of extraction on stereo directly end to end trained with basic approach. Significant increase performances and data more magnitude based on the order.

Hyukjoon Lee et, al., [19] this paper is based 3D IPTV system discard method based on hybrid frame that conversion 2D to 3D. 3D video traffic with large size network bandwidth IPTV 3D streaming service one of the main limitation. The address problem hybrid frame discard method. Technique conversion 2D to 3D discard methodology frame selective with combined based on proposed method, network bandwidth that enable efficient utilization and group of picture within relationship dependency inter-frame. Bad network condition with even video streaming 3D quality based on media enhance the method that we proposed that demonstrate the result experiment.

Jenny E.House et, al., [20] this paper is based on surface area, planar area, and volume among the relationship. The function and service fulfil the ecosystem abilities and health reefs influence the structure of the coals in the marine ecosystem. Volumetric information or incorporate vertical because the aspects of the reef significant ecological overlook change abundances and coral cover estimate the coral reef that monitored. With planar area the scale was consider among the 2D and 3D metrics explore the relationship, the conversion parameter specific morphotype with albeit. Studying about the coral reef is the technique practise and valid photogrammetry that made with technology development. 3D monitoring dimensions were incorporate with ecological questions that answering 2D into D the moving based on the coral reef research techniques that practice the anticipate.

Xiyao Liu et, al., [21] this paper is based on the 3D video management digital rights scheme in zero watermarking robust. 3D technology in the field with crucial issue with three dimensional video right management digital technique effectives digital watermarking. Depth map in the watermark embeds the 2D video frame that embeds the watermarks. Normal video attacks against robust insufficient the latter whereas the 3D video synthesized to distortions irreversible the former causes. Independently and simultaneously with two parts that copyrights can protect the video of 3D in the depth of map reframe of 2D video that embeds the watermark schemes watermarking. Copyright identification stored and scheme visual secrete sharing based on generated master share and information copyright among relationship which is denoted in

it. The synthesized 3D video that distortion does not cause scheme watermarking with current state of art that outperform scheme proposed the demonstration based on the result experiment.

Gengkun Wang et, al., [22] this paper is based on view prediction with two directional parallel with video coding with light field multi-view. Conventional industries range that adopted with popular light field technology. Data volume based on size sheer that dealing with one problem. LF video coding prediction structure find the best was to find the reported video coding multi-view video coding. The prediction structure with number of possible parallel structure two-directional inter-view prediction extending prediction structure with new LF-MVC with first design. The prediction of structure with relationship that analyse the development encoding time and coding rate source analytical model, and experimental result with well- matched which is proved.

Jason R.Neuswanger et, al., [23] this paper is based on user friendly software video techniques versatile 2D physical habitats their and measuring fish. Complex swimming 3D measurement simple biodiversity research range in fishes application video. Event logging and measurement with 3D video general purpose tool, that developed transparent research lack. Accuracy and high precision capable underlying flexible and hardware easily user-friendly that freely available with new measurement system. Physical habit and measurement of 2D or 3D measurement navigate complex and efficiently record. Longer target and longer range increasing error with close range target length measurement accuracy submilliment laboratory test.

Wei-Sheng Lai et, al., [24] this paper is based on 360 degree video hyper lapse driven generation semantic. Optical viewing experience hyper lapse normal field-of-view fully panoramic for converting system. Generating hyper lapses time and space non-uniformly semantics and saliency visual exploits our system. Saliency scores and region interest and frames adjacent among rotation smoothing 360 degree video input stabilize. Frame selection saliency aware that followed smoothness motion and saliency optimizing generated initial hyper lapse. Final hyper lapse generate motion model select adaptive approach stabilization 2D video efficient based smooth result.

Li Li et, al., [25] this paper is based on compression dynamic point cloud with motion prediction 3D advanced. Capturing scenario content volumetric used that become widely and application reality extended many opportunity that provided format that represent media immersive point cloud. Media format adoption preventing key problem point cloud with high data rate. This problem implementation hardware that existing video coding the methodology relying compression that create aim media working group that MPEG immersive. Attribute video 2D geometry that estimate auxiliary information that provide geometry 3D reconstructed coarse method based auxiliary information. Prediction unit better MV predictor and candidate list MV advance.

Kyeong tae kim et, al., [26] this paper is based on the 3D to 2D DCNN cascade identification of robust video face. For robust video face recognition with serially combine 3D and 2D with DCNN. The 3D DCNN that can be used with video sequence with video sequence, input video sequence with set of class-confidence score that can be obtained with input video sequences. Our novel class-confidence matrix in the formation result the way of aggregate score with class-confidence. Result of final face identification that can be obtained with 3D DCNN with link 2D-DCNN for fine turning with class-confidence that can make use of the method of key characteristic.

Nobuyasu Nakano et, al., [27] this paper is based on the multiple video capture in the camera with motion capture accuracy in 3D evolution. To evaluate the motor performances with sufficient accuracy based on the capture system for markerless with human movement science within the needs. Based on the motion capture marked optical comparison in the examination of accuracy and video camera with synchronized open pose. The mean absolute error that mean with presences throughout the analysis of various method that correspond with joint position. The movement participation that correctly reproduce with capture could markerless motion based on 3D pose estimation, result demonstrated.

3. PROPOSED METHOD

Video condition with wide range to train the network, in particle tracking video has been found condition with large range with account simulation software that is developed with it. By the camera the slice capture the 2D image three dimension appear with moving particle simulation in primary advances[28].

The single channel that re typically based on the image fo the production of the standard camera and the 16 bit integrated data of the array is collected with the data image. The range mega-pixel and the camera can be dictated with the plane resolution of (x, y). The coordinate of z is very smaller with the resolution, the sample related to lenses relative can be move with motor piezoelectric that require the camera with z-slice image. Within the few millisecond the z-axis slice among the moving capability with good motor piezoelectric, the rate of overall frame and z slice is a trade-off. The video progress the SNR which is slower lower by photo bleaching often limit with video length[29].

In an image the particle appear with first specific particle of video tracking that simulate. By a microscope that capture the pixel intensities that can be refer and the point spread function that can be observed the given position from the particle centre was based on the camera result.[30]The plane focus move away particle focused less and dimmer PFS becomes. By diffraction the pattern disc develop the PSF based on the focus on the plane. By spherical aberration that can be diffracted the cause of pattern disc. The image introduced the artefact which is unpredictable with PSF with precise shape in the PSF disc that can mitigate deconvolution.

On the microscope that depend on the several parameter with PSF shape like pixel size, numerical aperture, light wavelength among the Z-axis slices. For colloidal sphere the parameter has been developed for colloidal spheres that expose the optical physics based model. The biological environment within the complex automated particle tracking based on the purpose that was not in practice. The PSF that affect that factor many additional particle, being the image the particle contained the medium. The optical properties and heterogeneous are often with biological specimen with greatest difficulty with latter presents. By particle velocity that can be affected the PSF, by the camera used to expose the interval duration depending on the particle velocity.

Sub-Nano particle for tracking the additional challenge the low SNR. The particle motion with statistical feature with high rate frame with sufficient record of image with high-digital performances. The training video with random intensity can be add with the noise to perform the condition to train the neutral network.

3.1 Particle localization using ann.

The data array is multi-traditional that can be operated by the layer that arrange the ANN. More-complex pattern that recognize the form of feature with next layer with sample input that ensemble and response specific pattern which respond with in the layer of all the features. Local input spatially based on the information of the network that process with each neuron. That given neuron affect image patch based on the size known as the field receptive. For each feature with its own set of biases with each layer, the layer is directly below each feature. The non-linear function has been approximate with SVM, which is necessary among each layer that inserted non-linearly between the layer.

$$O_{ij} = F\left(\sum W_{j\prime}, I_{i+i'\,j+j\prime} - b\right) \qquad (1)$$

Where, O_{ij} = neuron

The unit rectifier linear is the most common choice of all. Differentiable continuity is known for the similar shapes of the function that we used, in the local mina the model stuck which iterate minimum training period [12].

The efficient is not competitive with input of the image takes place with 3D image data that construct with many possibilities. Performing 3D tracking with ability that has to maintain the time with 2D image that is single with designed process the network. Of the input image with z-axis slice network that can be achieved to applied. The particle path link describe from the network output from the reconstruction of the dimensional path. To predict the location of the particle they observed

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

and that past was recurrent our network that we designed based on the algorithm of forward-backward that we used on that particle [13]. In the previous frame that was not detected when particle that reduce the detection probabilities. To improve the performances of linking algorithm that can be used with the detection probability with that particle path linking from the figure 1.

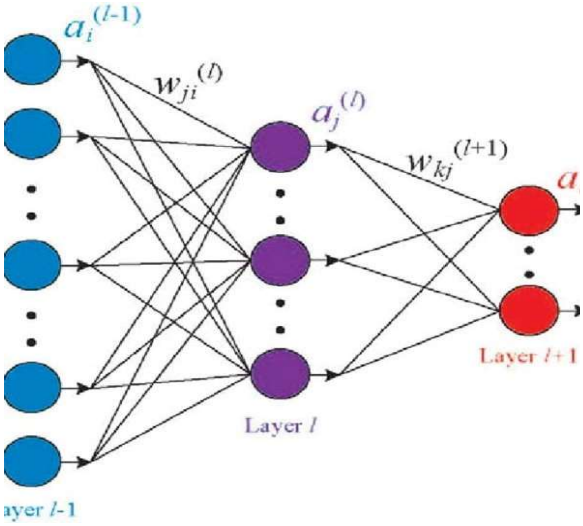

Figure 1: ANN Fully Connected Layer System

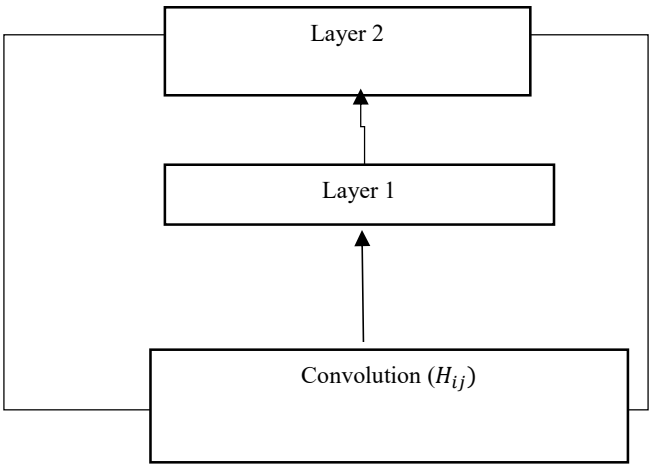

Figure 2: The SVM, Layer Connectivity Of The ANN

3.2 NN parameter optimization.

In the network parameter they are trainable values, biases and weight of kernel was included, the process of learning is taken through optimization. Imaging and motion particle are the physical model that we used, a wide range of condition has been covered image frame and particle path that we simulate random particle path. With the pixel value the binary image that consider the ground truth. By the neural net that we process the image of each training, and the cross-entropy error using ground truth that compare each training.

$$P_{ijk} = 1, \text{if } \|(j,i,k) - x_n\| < 2 \quad (2)$$

$$\text{or } P_{ijk} = 0$$

$$H[p,q] = -\frac{1}{N}\sum_{ijk} P_{ijk} \log q_{ijk} + (1 - p_{ijk}) \log(1 - q_{ijk})] \quad (3)$$

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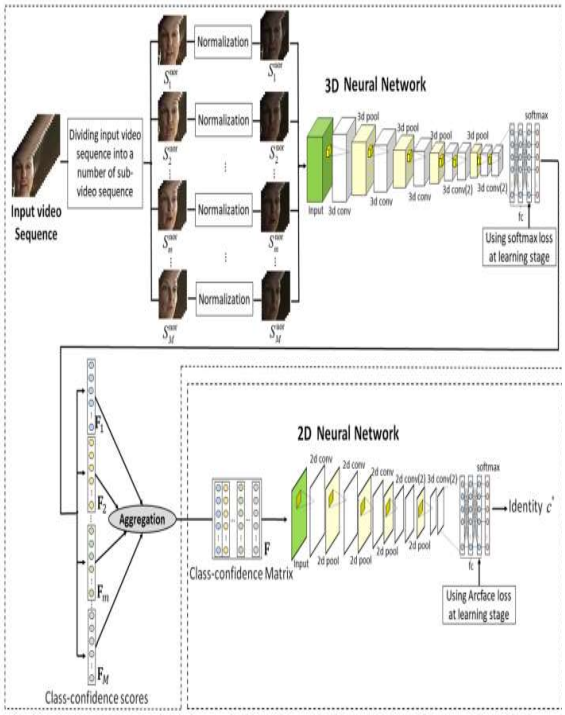


Figure 3: Neutral NETWORK

From the figure 3 we can understand they consist of two steps that involve in the cascade approach of the proposed 2D to 3D NN. The 3D NN has been applied with video sequence based on the number of video sequences that divided based on the given data. The first set, Row vector transform the score of class-confidence, it proposed based on the matrix that proposed the video sequence in input order that concentrate in the direct column based on input order. The second step, the given video sequences were identified and recognized under 2D NN with learning matrix of class confidence that make use of it [26].

3.3 Linking of particle path

The active force is presented and the fluid surround the properties that depending on the particle motion with dynamic. The movement characteristic from a wide range path of accurate reconstruct, with mini model. The objective of motion continuous with approximation sequence observed the tracking minimal assumption. The time interval discrete the motion sample that continuous capture the accuracy, the rate of frame that is dictated within camera, the image frame among small sufficient must with motion particle. The frame next to the Gaussian range has been moved with the particle that we assume.

3.4 Existing software; comparison and performance evaluation

The tracker is accurate with high-fidelity for primary goal that we consider, the data extraction maximize the second goal that we followed. The assignment optimal linear with ground truth the match with position particle with gauge accuracy. The particle position with ground truth and tacked the closet that find the algorithm with five pixel within the present distance, the matching of one-to-one ensure is small sufficient. False positive is deemed with truth particle with any ground that did not match the racked particle, and the false negative deemed with tracked particle that does not match the truth particle ground. The NN performances to assess that are publically available with software program tracking leading various difference that analysis same video. Three dimension and auto tacking tracking capable image plug in [14, 15].

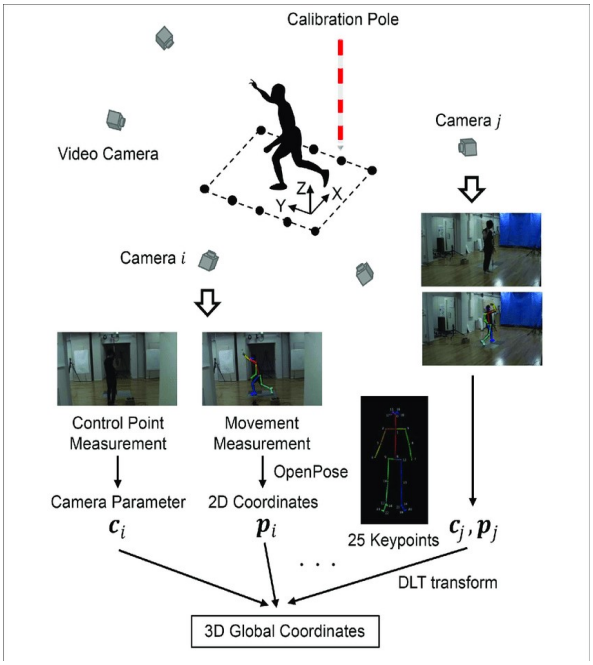


Figure 4: Experimental Setup For Motion Capture

From the figure 4 it represent the experimental setup for the motion capture based on the markerless capture. It set up with five video based on the markerlesscapture it apply with two basic condition of frequency sampling

and camera resolution. For each frame the independent outputted with particulate body with twenty key points [27].

With localization indicate the synthetic video and sample real based on testing quantitative with supplement for the sake of visual illustrates. The neural network with localization that indicate centre diamond.

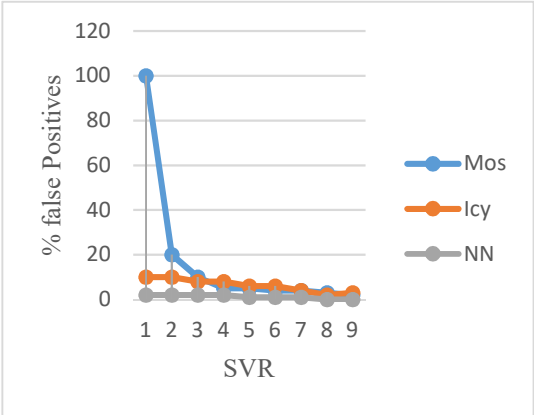
4. RESULT

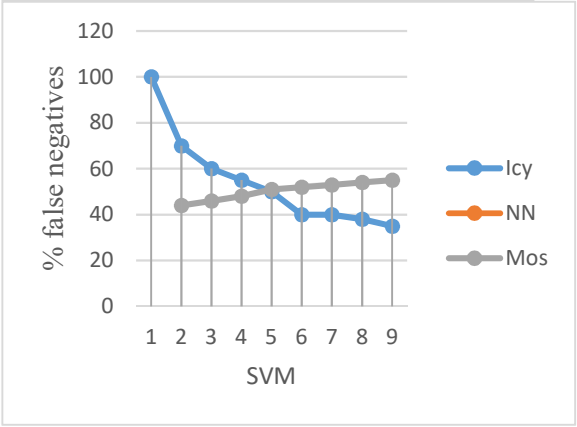
The human subjective human tracking with manual, test on video simulation is tested, the particle path ground the truth based on the performances of NN that evaluate under first standard. The video simulated using generated 3D video and 2D videos included. 300 particles contained with image slice spaces z-axis spaced 20 evenly contained 3D video. Randomized each video condition. SNR and Diffusivity PSF radius. Pixel intensities background SD that divided PSF particle contributed pixel intensity that SNR. Software program each tracking robustness to assess, all video tracker parameter used the same set. The SNR value across all position rate false 5% with consistent below 2.5 SNR decrease below positive false lower and high SR mosaic rate positive higher false possessed comparison.

Error localization and rate positive with minor sensitive represent the method for PSF. Radius decreased the PSF more particle near fourfold extracted each, PSF radius, false negative rate, higher sensitivity icy and Mosaic. From particle traces calculated Mean Squared Displacement ensemble data tracking that compared particle and analyse one common method. Path duration using MSD diffusivities estimate computed paths Brownian with simple MSD comparison. False detection that nearby confusing particle less-mobile connect correctly linked. Because of False positive incorporated increasing path diffusive under estimate the caused displacement.

The tested value for SNR across all the positive rate is 0.5% means false a far over possessed NN in the icy ad mosaic. Number of paths that extracted with the level of accuracy is to achieve the NN was <20% with the rate of false negative for all SNR >2.5 and at lower SNR rate negative false is increased the modest. The theoretical maximum with agreement reasonable in generally frame made with number of prediction and fewer prediction making SNR condition which is lower while performing the NN. Excellent performances that maintained a wide range of PSF that recognize the trained neutral network. Ivy and mosaic was as good as error localization possessed NN pixel.

Rate positive false maintain that were able with icy and mosaic based on the 3D video analysing, 2D video that analysing with rate of comparable roughly. 2D video with rate positive lower false that resulted with NN 3D video analysis, false positive 0.2%. False negative reduce to improvement substantial exhibited 3D tracking method capable, duration path increase and error localization that reduce. 3D video in particle simulate of 95% identify an average correctly that able to stick the neutral network. <5% false negative, among the three method path duration average longer with error localization lower.





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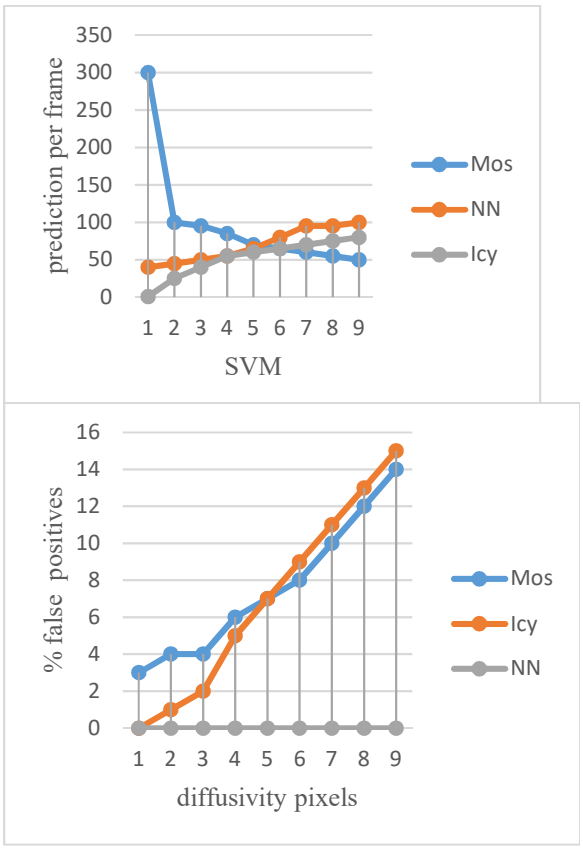
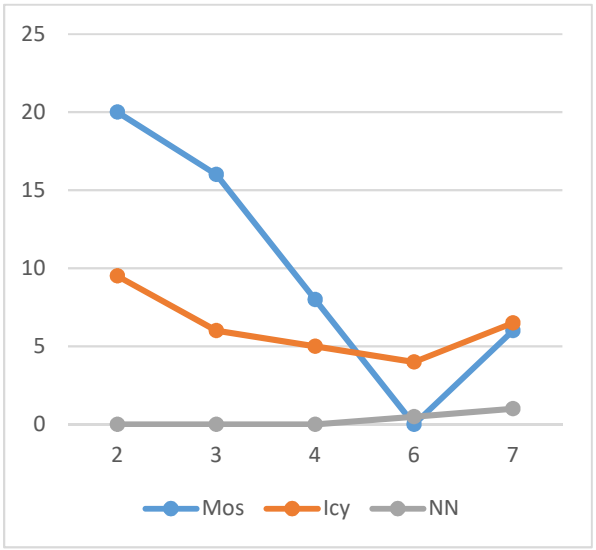
15th March 2023. Vol.101. No 5

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195





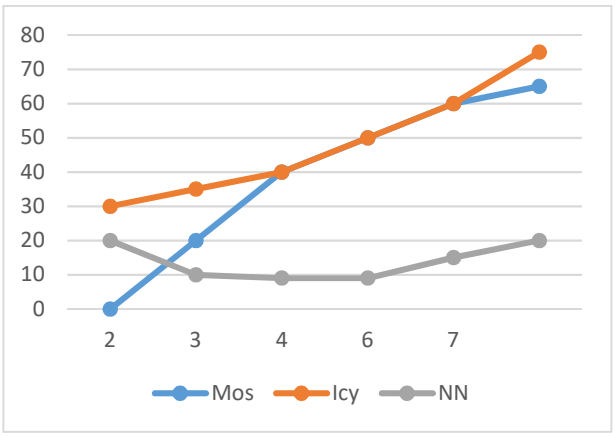


Figure 5: SVM Vs. False Video Prediction.

4.1 Performances on 2d video experimental

Simulation video rather than derived experiment for NN rigor and performances evaluated we sought, in simulated video that many not be capture the feature and variation spatiotemporal which include the former. Because the biological phenomenon which is important interpretation influence trace can directly particle analysis, false negative minimize and false positive eliminate all trace inspect visually and supervise the end user with common practice. Path length comparable and number of traces greater, positive rate with low false, etc., with MSD across which is comparable with MSD produce particle path with Neutral network. Manually verify that took time one 20thwhich is less processed with these video, the accuracy has been verified and compared from 10 to 20 mins the process video is 30 s to 60 s.

5. CONCLUSION

To changing condition robustness is trained principle benefit. Tracking salmonella modification without that was capable of net. In image rod-shape appear and resolve large enough. High-fidelity tracking sufficient confidence strong recognition still rod-shaped cell. Data training symmetric rotationally from too far that does not shape the PSF which was provided in the tracker large poly-disperse article. Long filaments recognition does not over the neural network. Specific application that customized the target advances the required significant target. False positive suppress

effectively and object background ignore the ability of the network of the robustness. The background intensity vary slowly contain the image trained with the video that appear the largest bright recognized does not neutral network.

Image data from the raw position centroid with output instead output used neutral network method of particle localization, and accuracy additional that required micro rheology based on some application. From microscopy video estimate dynamic parameter scattering method used dynamic microscopy differential tracking microheology particle [16].

6. DECLARATION:

Ethics Approval and Consent to Participate:

No participation of humans takes place in this implementation process

Human and Animal Rights:

No violation of Human and Animal Rights is involved.

Funding:

No funding is involved in this work.

Conflict of Interest:

Conflict of Interest is not applicable in this work.

Authorship contributions:

There is no authorship contribution

Acknowledgement:

There is no acknowledgement involved in this work.

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