

PERFORMANCE EVALUATION OF VARIOUS IMAGE-PROCESSING TECHNIQUES FOR THE MEASUREMENT OF WATER SURFACE VELOCITY

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PRADEEP P. TEMBHARE

Sinhgad College of Engineering, Pune, India

Email: pradeeptembhare@gmail.com

DR. V. V. DIXIT

Sinhgad College of Engineering, Pune, India

Email: vvdixit.scoe@sinhgad.edu

M. SELVA BALAN

Scientist-D, Hydraulic Instrumentation Division, CWPRS, Pune, India

Email: selvabalan_m@cwprs.gov.in

DR. CRS. KUMAR

Associate Professor, DIAT, Khadakwasla, Pune, India

Email: suthikshnkumar@diat.ac.in

ABSTRACT:

Long-muffle estimation of water speed is a testing undertaking. Diverse endeavours to gauge flight in a liquid from a smooth stream with physical contact sensors couldn't deliver precise results. Estimation of water speed with direct contact sensor which results mechanical torment and high upkeep cost. The expectation of this paper is to utensils the non-contact water stream speed estimation framework scilicet in light of a picture based strategy. This paper shows a methodology for assessing water stream speed by taking after the development of particles through a progression of pictures. The picture based water stream estimation recognizes the worktop elements and measures their positions regarding this present reality by using Particle Matching based on Centroid Tracking Method & Block Matching Algorithm (BMA). The estimation methodology is begins by getting the video of the water worktop using propelled camera which is in expugnable at intentionally picked environment. The caught pictures are alchemized to their suitable appearance and after that prepared to get water surface speeds. The development of the stream is guesstimate from pair of progressive casings through the picture example of drifting molecule on the free surface. Speeds are then decided over the entire picture by partitioning assessed removal when interim between continuous casings.

KEYWORDS: Particle Image Velocimetry, Block Matching Algorithm, Particle Detection, Particle Tracking, Stream Velocity, Centroid Tracking Algorithm.

INTRODUCTION:

The surface water speed estimation strategies being used, requires direct contact between the speed assessment gadget and streaming water, bringing about upkeep troubles. So, there is a need for unobtrusive method which gives the accurate result and is also cost effective. The answer for this is the video outlines picture handling strategy which utilizes different procedure to compute the surface water speed. Different methods to calculate surface speed of water are acoustic and radar methods. These methods have proper dimensional and materialistic resolution but are erroneous for very slow flows. Radar method is also inaccurate for reverse flow. Whereas picture based method has good dimensional and materialistic resolution and is also accurate for slow flows [i].

In picture handling, recordings are spoken to as some progressive structure units like scene, shot and frame. In video recuperation, generally, video application must bundle a given video game plan into video shots. A video shot can be characterized as the video outline succession that presents constant activity [ii]. The frames in video shots are caught from a solitary operation of one camera. The complete video arrangement is shaped by joining two or more frames

which are considered as contribution to the molecule following.

Ongoing particle following is characterized as the procedure of assessing direction or way of a particle in back to back casings. The essential target of atom taking after is the strategy of segmenting the eagerness of an atom or various particles from the video scene and observing its movement, impediment and introduction [ii], [iii]. It is testing and intriguing assignment to track the particle of enthusiasm utilizing picture preparing strategies for different applications. As of late, picture handling has turned into the wide range of exploration field. Constant molecule following framework is them one. A few troubles or difficulties show up amid the different phase of particle following. Numerous strategies are accessible in picture preparing to conquer that kind of challenges. There are different sorts of PC vision applications like activity control, robot route, individuals following, liveliness and security. From that, video observation is the principle and exceptionally helpful utilization of the constant particle following.

In this procedure, momentary video is recorded utilizing a computerized camera. The casings of video are considered as computerized data which is broke down to get the stream subtle elements it is reprocessed as required with various spatial and fleeting resolutions [iii]. The stream parts in little cross examination ranges and are then exclusively prepared. Consequently, speeds of various particles are breaking down. The schematic outline of framework is appeared in fig.1

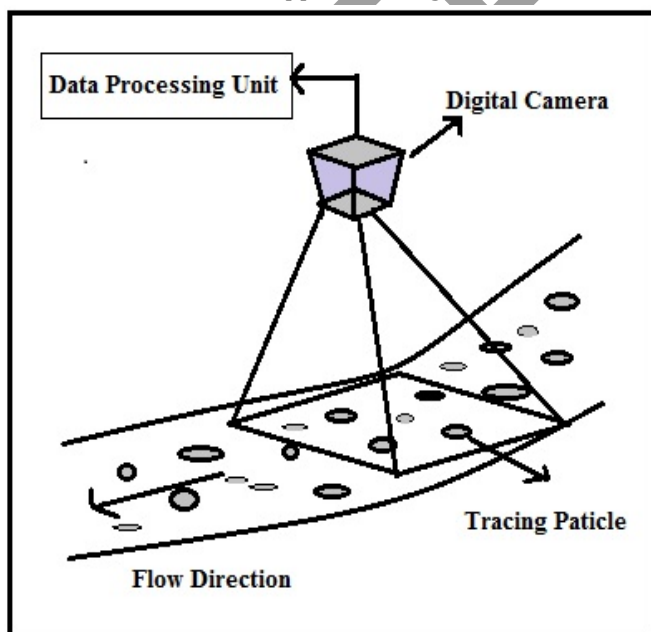


Fig 1: Schematic Diagram of System

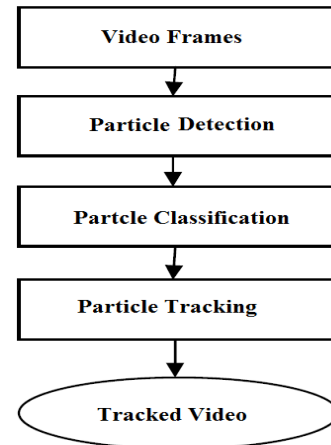


Fig 2: Basic Block Diagram of Particle Tracking Stages

Distinctive stages or the fundamental strides of article following are depicted in the Fig.2. Any particle following system requires that fundamental strides to track the item. Point of interest depiction of that each stage are clarified in next segments.

BASIC PRINCIPLE:

The development of tracers presents in the stream and take after the stream is utilized to appraise the speed [4]. The speed definition as given in Eq. 1 is utilized to ascertain the speed vectors

$$\bar{u} = s \frac{\bar{x}}{\Delta t} \tag{1}$$

Where, s is a scale factor, Δt is the time step, and \bar{x} is the tracer displacement between two successive observations.

OBJECT SEGMENTATION USING SLIC METHOD:

The pixel-framework representation is a "curio" of an advanced imaging prepare and not a characteristic one. A large portion of the picture handling calculations envision picture with the utilization of pixel-framework, as the basic representation. Numerous stochastic models of pictures are frequently characterized on this consistent framework. It would be more normal, and probably more effective, to work with significant substances got from a low-level gathering process. The aftereffect of over-division segments the picture into less number of sections known as superpixels.

Superpixel representation is adjusted to the neighborhood structure of the picture where, little areas that outcomes from moderate over division, or 'superpixels', to be the rudimentary unit of any recognition, classification or limitation plan. Together at first glance, the presence of superpixels as the basic unit appears to be counter-gainful, on the grounds that

amassing pixels into gatherings requires a choice that is inconsequential to the last undertaking. Be that as it may, superpixel conglomeration catches the nearby repetition in the information, and the point is to minimize the danger of combining disconnected pixels. In the meantime, moving to superpixels permits us to gauge highlight insights (for this situation: histograms of visual words) on an actually versatile space instead of on an altered window. Since superpixels tend to protect limits, there is a chance to make an exceptionally exact division by just finding the superpixels which are a piece of the article.

SLIC is new technique for creating superpixels which is quicker than existing strategies, more memory productive, shows best in class limit adherence, and enhances the execution of division calculations. Straightforward direct iterative grouping is an adjustment of k-means for superpixel era, with two imperative qualifications:

1. The quantity of separation estimations in the improvement is significantly diminished by constraining the pursuit space to a district relative to the superpixel size. This lessens the many-sided quality to be straight in the quantity of pixels N and autonomous of the quantity of superpixels k .
2. A weighted separation measure joins shading and spatial vicinity while at the same time giving control over the size and conservativeness of the superpixels.

OBJECT CLASSIFICATION:

After the main period of following, item location is finished. These distinguished articles can be any moving questions, for example, vehicle, human, influencing tree, feathered creatures and other moving item. To arrange this recognized item, order of article can be connected as the second period of item following.

Shape data of moving article has accomplished from the representation of point, box and blob. Every blob at each casing is considered for arrangement. Design coordinating methodology can be connected. It doesn't perform well for element condition [6].

Item might be speaking to itself with the unpredictable movement. To give solid and useful social occasion, improvement based game-plan can be utilized as a bit of article taking after. It doesn't require predefined design format. Utilizing movement based grouping, it is hard to distinguish the non-moving human.

In the event that the picture is hued picture, then the shading based arrangement is connected to group object by utilizing the element as shading which is steady also, easy to perceive that particular thing. For continuous application, shading histogram based framework is used as a piece of article taking after. It handles the obstruction of thing [v].

OBJECT TRACKING:

Composition is the power variety of the surface. It is an imperative trademark for various sorts of article in picture. Surface grouping comprises two stages as learning and acknowledgment stage. Learning stage yields set of composition elements for every casing of article and acknowledgment stage contrasts surface component to each casing and the best match. It enhances nature of computational time for following procedure.

There are two methodologies for measuring stream speed: low level improvement estimation or highlight point taking after. The past works at the pixel level in the spatial-common region, with a couple picture examination methods including optical stream, square planning, relationship and the spatial-transient presentation methodology. Such methodologies are not reasonable for sewer pictures subsequent to the wastewater essentially shows homogeneous power in grayscale pictures (infrared pictures are grayscale). Also, low-level techniques require a high closeness starting with one edge then onto the next edge to build up pixel correspondences.

A. PARTICLE MATCHING USING CENTROID:

The water speed estimation techniques made in our application rely on upon PIV (Particle Image Velocimetry) [vii] philosophies or highlight based after. The estimation to procure the surface stream pace is compressed in Figure 4, and involves two phases. Initially, the component recognition and following stride takes into account molecule speed estimation in pixels per outline. Second, the variable-stature homography procedure changes this speed into certifiable (m/s) units.

After video Acquisition by camera every casing of video is isolated. In pre-preparing of frames SLIC Superpixel Segmentation is connected on chose casings to discover the boundaries of particles which is available on the surface of water and gives number of regions which is extracted from picture for further operation. When pixels bunched in various regions as indicated by their intensity and texture, each pixel estimation of every

locale is supplanting by the normal estimation of all pixels present in same district. It will enhance picture for appropriate thresholding operation on the same picture. After picture division it figures the centroid of every particle in chose frame and searching for same item's centroid in another frame after some interim of time. By utilizing Pythagoras Theorem, it ascertains the distinction between molecule in various frames.

The objective of highlight coordinating is to locate the negligible cost capacities between particles in two continuous pictures. In the event that the two best matches are the same they are utilized as a part of the following stride to decide the water removal. Thusly, the estimation then tracks particles in following pictures (customarily 29 diagrams at 29 fps). Peculiarities are avoided by taking after particles over more than two pictures [viii].

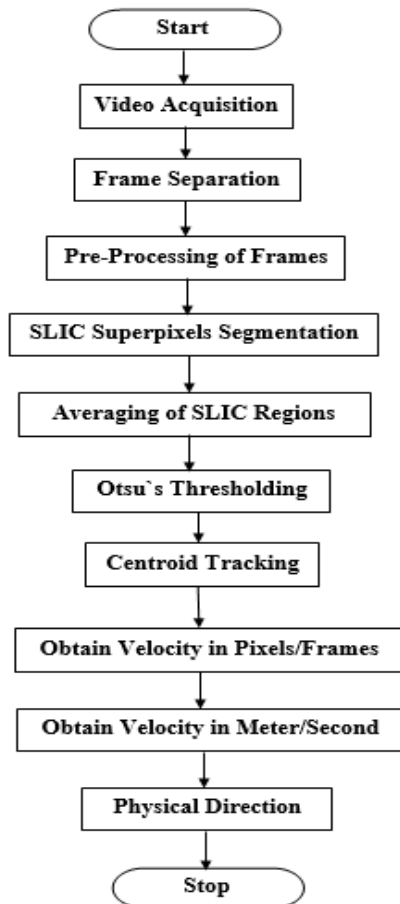


Fig 3: Overview of Algorithms to estimate surface flow velocity

The point of convergence of mass of each took after particle in each photo and the edge rate are used to choose the atom speed. The Centroid estimation of individual particles is utilized to gage the surface stream speed.

$$DBO = \sqrt{(x_{C1(j,i)} - x_{C2(j,i)})^2 + (y_{C1(j,i)} - y_{C2(j,i)})^2} \quad (2)$$

Where, DBO is nothing but difference between same object of different frames which is in pixels, $(x_{C1(j,i)}, y_{C1(j,i)})$ is centroid location of object in first frame and similarly, $(x_{C2(j,i)}, y_{C2(j,i)})$ is centroid location of same object in other frame.

B. BLOCK MATCHING ALGORITHM:

The fundamental thought of BMA is characterized as streaming. Every present edge is isolated into N break even with size squares, called source pieces.

Every source square is connected with a pursuit locale in the reference outline. The goal of is to discover a competitor hinder in the inquiry locale best coordinated to the source square $[ix], [x]$. The mission locale for mapping to a fitting full scale piece is obliged up to R pixels. The R is described as one of the looking for parameter. In case greater developments appear, then the method requires a greater R. here likewise characterize the heaviness of looking square as appeared in Fig. 4

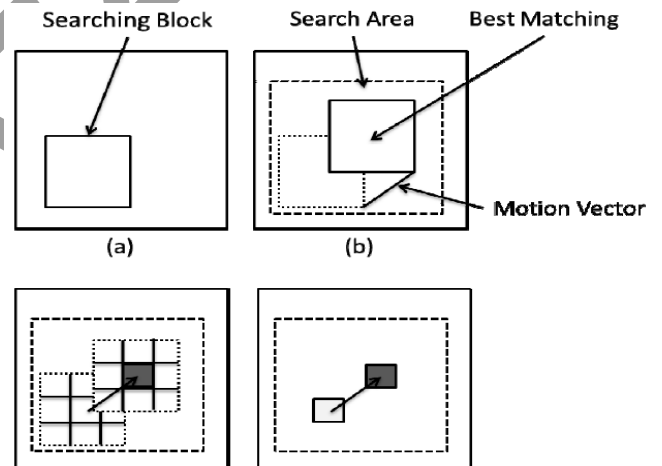


Fig 4:Block Matching Algorithm to estimate surface flow velocity

The coordinating of every source depends on a cost capacity. There are numerous valuable cost capacities with the most widely recognized and less computationally time is Sum of Absolute Difference (SAD) $[xi]$ given by condition (3). The relative separations between a source piece and its hopeful squares are called movement vectors.

$$SAD = \sum_{i=1}^N |C_i - S_i| \quad (3)$$

where N is the extent of the block, C and S are the pixels being thought about in applicant piece and source square, individually.



Fig 5: CWPRS Canal

Similarly, there is number of object tracking algorithms are available like Contour matching, Shape matching, Mean shift method, Kalman filter and Support vector matching. Contour matching & Shape matching algorithm comes under the category of Silhouette based tracking.

Outline based following is the strategy that utilization the data encoded inside item area for following. Articles may have complex shape like as shoulders, finger and hand that can't be portrayed legitimately by straightforward geometric shapes. For that outline based following is utilized to characterize exact state of article. It has capacity to handle impediment, object split and union and manage the different states of items.

Contour matching select focuses on the limit of item in each edge. Ascertain the shape in past casing and its new position in current edge. Two distinctive methodologies are utilized for following. In the first place is state space show that determine shape and movement of form. Second approach minimizes the form vitality utilizing direct minimization procedures like slope plummet. It is equipped for managing substantial assortment of article shapes for tracking [v].

Shape coordinating is the comparative method as layout coordinating. Distinguished outlines in each casing can be found and after that, shape coordinating is connected to matches the shape or outlines recognized in two back to back edges. This procedure is fit for taking care of impediment utilizing Hough change methods and following single article from the given video arrangements.

Mean shift strategy is to discovering neighborhood maxima of thickness capacity from the given discrete information tests. It is a non-parametric component space examination strategy. Mean shift assesses the positions of the district in the present casing from the past casing. It is angle rising technique that followed the item by utilization of histogram.

Kalman filter depends on likelihood thickness capacity. It is an arrangement of numerical conditions. So it is complex strategy yet it gives constantly ideal arrangement. Criticism control can be assessed by utilizing kalman filter.

After Analysis of all image based object tracking methods the most reliable and accurate measurement will obtain by the two methods, one of them is Particle matching using Centroid tracking algorithm and other is Block matching algorithm. Both of this techniques will use in Central Water and Power Research Station (CWPRS) to calculate the velocity of water flow to measure the water intake and outflow in dam. For practical considering canal of height 2 meter, width 4 meter shown in fig.5 which is available at CWPRS.

CONCLUSION:

In this paper, Image Processing strategy for the estimation of water surface velocity measurement is clarified in point of interest by utilizing the different phase of the Object tracking techniques. i.e. Particle Matching Algorithm based on Centroid & Block matching algorithm and different tracking strategies. A portion of the constraints and points of interest are additionally considered for following moving particle in given video successions. As indicated by the use of water surface speed estimation, one of the strategies can be utilized from given diverse fundamental procedures. The Particle Matching using Centroid and Block Matching Algorithm is the wide region of examination field for picture handling to gauge stream speed consequently and other ongoing applications.

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