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Photogram - Image Comparison and Identification

Thakkar AK*

Retired assistant Director Forensic science Laboratory, Gujarat, India

***Corresponding author:** Thakkar AK, Retired assistant Director Forensic science Laboratory, Gujarat, India, Tel: +91 9979954667, E-mail: tashok35@gmail.com

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Abstract

A human being is having physical and biological body structure, even though each and every individual is having his own blood group, hair color, retina color, skin complexes, height, breadth etc. that result in his own bodily structure that differentiates with the other individual. After the certain age of subject nearly about twenty years, height or length of his organs or limbs are not increases and fixed bodily structure is built up. The identity of the individual can be done by photo ID card, certificates, and another document, which differentiated the individual by observing, describing, and measuring size and shape in the form of signature, hand writing, passport, fingerprint, voice print etc. All these tools of identity can be manipulated by easily available handful techniques. The author introduces image comparison tool, an effective way of identity based on the photogrammetric principal that measure the distance between two points that lie on a plane parallel to the photographic image plane. The fact is utilized and studied having scientific, logical and verifiable proof. It is a photogram – the biometric and geometric design of the image that mathematically is compared by addition and multiplication of relative specific numeric figure and forming the equations. Relatively proportionate photographic foot-rule height of the subject is additional important identity feature of an individual that measured with the aid of light beam. The photogram techniques are utilized even if the front facial appearance of a subject is not visible. Make-up and camouflage miss-lead, the subjective comparison but the comparison by photograms give the correct answer. Forensic cases of a forged signature, duplication of painting (sculpture), identification of subject are solved by comparison techniques of the photogram.

Keywords: Photogram; Photographic relative relations; Identity sequence; Relative-proportionate foot-rule height; Fusion point; Photographic unit of length

Introduction

The study of anthropometry is based on the concept of sacred geometry. The human body and its various indices are well studied by many authors. Golden ratio means, the human body. It is designed by almighty God and has incorporated into the genetical system, giving rise to constant dimensions [1]. Forensic science has a method of identification such as finger print, foot print etc. On further development, the scientist is deriving other methods of identification such as silhouettes, shadow, and sun-light, color shade, lip print etc. The author is introducing "Photogram" (Biometric method of image comparison) based on the photogrammetric principle that is well developed and exploited in the scientific world [2]. Human identification, using body shape information is well documented by various branches of science [3,4,5,6] An earlier scientist has attempted human height estimation using calibrated camera [7]. Relatively fixed distance height characteristic of the subject can be calculated by photogram technique. The aim of the article is to find out or to search out the missing subject from the targeted area, who is criminal and notorious to the society.

Photogram word is a combination of geometric design and measurement of the bilateral structural body points. Each and every individual is having a specific length of organ and the limb. The ending points of the organ or the limb are body point. Length line data between any two body points are specific for each individual. The standing position is the typical posture of a human being from head point to toe point. It is having three regions namely head region, a middle region, and leg region. Connecting any two to three lines from each region forms the specific geometric design of the structural body. Height is numerical data of distance between a head point and toe point. Reference points are middle line points of the image, namely head point, leg point, the junction point of the head and middle region and the junction point of middle and leg region.

The two images are relatively be compared by three procedural techniques of photogram namely equation comparison, height increasing rate comparison and super imposition comparison. A person can be pointed out even from his image having no front

facial appearance in the field work task by height increasing rate comparison and identification is proved in premises of laboratory. Field-work task requires little training, practiced, passions and understanding of the concept. Instruments that used are a simple camera and magnetic compass. All the comparison techniques are recordable and printable. Distance factor is 10-25 feet between camera and subjects and image height that selected is between 100-300 millimeters. The result is mathematically be derived with addition and multiplication of numeric figures, it can be either comparable or not comparable. Reproducibility factor of comparison is a correct measurement of body point line.

The government is forming rules, regulation, and lows (Penal code), but the person does not obey the rules and laws are criminal or notorious. The police department or investigating authority of the government is related to crime and criminal. The person gets bail during the process of judgment and hides his identity from the authority is missing a person or wanted a person. Probable location area of such person obtained during an investigation is targeted area, may be a railway station, aerodrome, bus-station, market or any public or private place. The person who is being searched does not know that he is being doubted by the authority. The photograph that obtained secretly from the targeted area is exhibit photograph (image) and photograph to be compared with exhibit photograph is control.

Theory, procedure of comparison and identification

The photograph is the image of a person with the background and image is a photograph without background. There is a mathematical relation between the height of the subject, the height of the image and the distance between subject and camera. (1) Image height is a photographic height of subject related to the distance. Bigger the height of subject bigger is the image height. (Distance is constant). (2) If the subject is snapped twice, both images will be of the same size or proportionally related to a height of the subject. (3) Bigger the height of image less is the distance.

If the 2D image is enlarged to the size of the subject, it will be cut out poster of the subject and the 3D object is the statue of a subject having proportionate measurable height, length, breadth etc. with respect to the outlook of the individual. Available data of foot-rule and subject clicked from a constant distance is used to calculate the height of the subject. It is obvious in the field work of photography to have the same size of the image with the different distance is never possible and to have the same size of the image for two subjects having different height with the same distance is also not possible. Enlarging or squeezing of the image or zooming of the camera lens is nothing but changing the distance. Proportion is a very specific mathematical relation between two numeric figures and can be converted into the equation. For example figure 1550.0 and 235.0.0 are proportional to each other. Mathematically it can be express as,

235.0 α 1550.0
1550.0:: 235.0 = 6.59574468085:: 1.00000000000,
235.0 X 6.59574468085 = 1549.99999999.
That is 235.0 is proportionally related with 1550.0 having connecting link 6.59574468085
Figure 177.0 is proportionally related with 1550.0 having connecting link 8.75706214689

Let there a sequence of three members (1550.0, 235.0, 177.0), where 1550.0 mm is the height of the subject, 235.0 mm is the height of control image and 177.0 mm is the height of exhibit image. Connecting link figures of the sequence are 8.75706214689, 6.59574468085, 1.32768361581 and 0.75319148936.

Mathematic relation between link figures is as below.
8.75706214689 x 0.75319148936 = 6.59574468083 --- Difference is 0.00000000002
8.75706214689 :: 6.59574468083 = 1.00000000000 :: 0.75319148936
6.59574468083 x 1.32768361581 = 8.75706214680 --- Difference is 0.00000000009
6.59574468083 :: 8.75706214680 = 1.00000000000 :: 1.32768361581
Connecting link figures are also proportionally related to each other.

Equations of sequence are as below.
1550.0:: 235.0 = 6.59574468085:: 1.00000000000
235.0 x 6.59574468085 = 1549.99999999 ---------- Figure 235.0 is directly related to 1550.0
1550.0:: 177.0 = 8.75706214689:: 1.00000000000
177.0 x 8.75706214689 = 1549.99999999---------- Figure 177.0 is directly related to 1550.0
235.0 x 0.75319148936 x 8.75706214689 = 1549.99999999--Figure 235.0 is indirectly related to 1550.0
177.0 x 1.32768361581 x 6.59574468085 = 1549.99999999--Figure 177.0 is indirectly related to 1500.0

Any sequence having three member as [A, B, C], where A is height figure of control subject, B is height figure of control image, C is height figure of exhibit image, and the 2nd and 3rd member are directly or indirectly proportional to 1st member is the sequence of identity. The direct relation is mathematical relation (MR).

Let three members sequence is (1550.0, 235.0, 177.0). It can be said as the both the images are of the same subject or both the subject of images have same height units. Exhibit image is smaller than control image. If the exhibit image is to enlarge up to the

height of control subject, it is to be relatively increased 1.32768361581 times per unit is a photographic relation of exhibit image with reference to 235.0 and 1550.0. Control image is bigger than exhibit image. If it is to enlarge up to the height of control subject, it is to be relatively increased 0.75319148936 times per unit is a photographic relation of control image with reference to 177.0 and 1550.0. Both Images will reach up to the destination at the same time. The images do not have indirect relation with the height data of control subject is un-identity sequence and both will reach at the different time. It is to conclude that any two images can mathematically be compared with the presumption that the subjects of images are having the same unit of height.

Mathematical comparison technique

Seven digit data after decimal point is used for comparison
(a) Data of identity sequence (1500.0, 235.0, 177.0) is as under.
(1) Height characteristic of control subject ----- Hs (con) = 1550.0 mm
(2) Height of control image (photograph) -------- hp (con) = 235.0 mm
(3) Height of exhibit image (photograph) -------- hp (exh) = 177.0 mm
(4) Proportion ratio of control::Exhibit = 235.0:: 177.0 =1.0000000:: 0.7531914
1.3276836:: 1.0000000 Control > Exhibit
Mathematical relation --- MR (con) = 1.3276836 and MR (exh) = 0.7531914
Photographic relation ---- PR (con) = 0.7531914 and PR (exh) = 1.3276836
(5) If control image is to enlarge up to height unit of control subject, it is to be multiplied with factor of sequence (F) = 6.5957446 ------ (235.0 x 6.5957446 =1549.9999810)
(6) If exhibit image is to enlarge up to height unit of control subject it is to multiplied with presumption factor of sequence (f) = 8.7570621-------- (177.0 X 8.7570621 =1549.9999917)
(7) D (con) < D1 (exh). D and D1 are the distance between subject and camera.

The data are very specific for these two images.
The equations can be derived from the above data are as under.
(1) hp (con) X F = Hs(con) ---------- 235.0 X 6.5957446 = 1549.9999810
(2) hp (exh) X f = Hs(con) ---------- 177.0 X 8.7570621 = 1549.9999917
(3) hp (con) X PR(con)) X f = Hs(con) ------ 235.0 X 0.7531914 X 8.7570621 = 1549.9998078
(4) hp (exh) X PR(exh) X F= Hs(con) --------177.0 X 1.3276836 X 6.5957446 = 1549.9999625
hp(con) X PR(con)) X f = hp(exh) X PR(exh) X F.
235.0 X 0.7531914 X 8.7570621 = 177.0 X 1.3276836 X 6.5957446 = 1549.999
Equation is having photographic relation is named as equation of photographic relation--- -- (EPR)
(5) hp(con) X MR(exh) X f =Hs(con)--------- 235.0 X 0.7531914 X 8.7570621= 1549.9998078
(6) hp (exh) X MR(con) X F=Hs(con)-------- 177.0 X 1.3276836 X 6.5957446 = 1549.9999625.
hp(con) X MR(exh) X f = hp(exh) X MR(con) X F.
235.0 X 0.7531914 X 8.7570621= 177.0 X 1.3276836 X 6.5957446 = 1549.999
Equation is having mathematical relation, is named as mathematical equation---------- (EMR)

Result of all the equations are same up to third digit after the decimal point that is presumption of having same height characteristic is correct.

Above equations if calculated using ten digits after decimal point, all will be correct up to sixth digits.
235.0 X 0.7531914893 X 8.7570621468 = 177.0 X 1.3276836158 X 6.5957446808.
1549.999999856623 = 1549.999999965575.
1549.999999 = 1549.999999
(b) Data of un-identity sequence (1550.0, 235.0, 242.0) is as under.

Height data of exhibit subject is other than that of control data, that is image heights are not indirectly proportionate to control height data.
(1) Height characteristic of control subject ---- Hs(con) = 1550.0 mm
(2) Height characteristic of control image ------ hp(con) = 235.0 mm
(3) Height characteristic of exhibit image ------ hp(exh) = 242.0 mm
(4)Ratio:- control :: exhibit = 235.0 :: 242.0= 1.0000000:: 1.02978720.
0.9710743:: 1.00000000 Exhibit > Control
Mathematical relation----- MR (con) = 0.9710743 and MR (exh) =1.0297872
Photographic relation----- PR (con) =1.0297872 and PR (exh) = 0.9710743
(5) Factor of sequence (F) = 6.5957446 ---------- (235.0 X 6.5957446 = 1549.9999610)
(6) Presumed factor of sequence (f) = 6.4049586 ---------- (242.0 X 6.4049586 = 1549.9999812)
(7)Height difference between control and exhibit image is 7.00 mm (242.0 – 235.0= 7.00)

The equations can be derived from the above data are as under.
(1) hp (con) X PR (con) X f = 235.0 X 1.0297872 X 6.4049586 = 1549.9999057----- EPR (con)
(2) hp(exh) X PR (exh) X F = 242.0 X 0.9710743 X 6.5957446 = 1549.9999810----- EPR (exh)
(3) hp (con) X MR (con) X f = 235.0 X 0.9710743 X 6.4049586 = 1461.6273119-----EMR(con)
(4) hp (exh) X MR (exh) X F= 242.0 X 1.0297872 X 6.5957446 = 1643.7156339-----EMR(exh)

It is to conclude that full size standing photograph of the subject having no front facial appearance can be compared with equations, whatever may the distance between subject and camera.

Equations of comparisons are
(1) hp (con) x PR(con)) x f = hp (exh) x PR(exh) x F --- (EPR)
(2) hs (con) x MR(exh) x f = hs (exh) x MR(con) x F --- (EMR)

Height increasing comparison technique

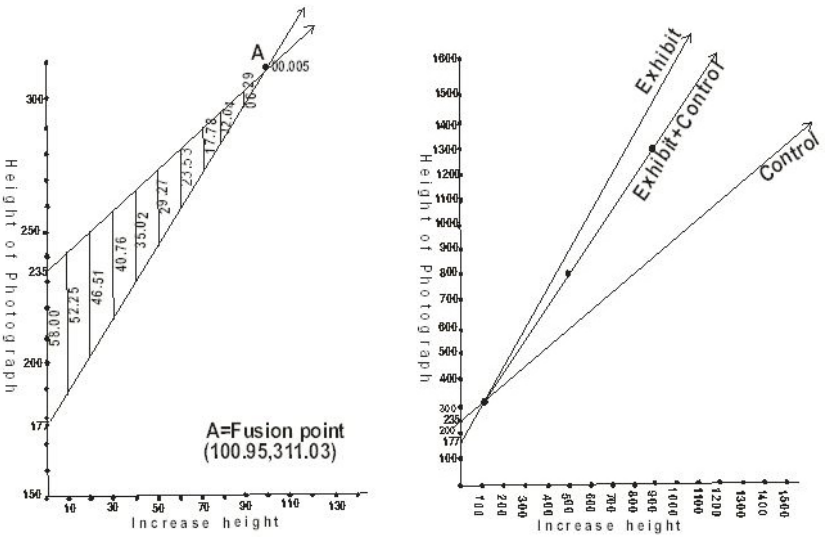
Identity sequence (1500.0, 235.0, 177.0)
Height difference between images is 58 mm. If height of image is increased simultaneously, the data will be as per chart as below (Table 1).

Increased height = height of image + unit increase X photographic relation.
PR (con) is 0.7531914 and PR (exh) is = 1.326836

S. No	Unit increase	Height of control	Height of exhibit	Height difference
1	0.00	235.000000	177.000000	58.000000
2	10.0	242.531914	190.276836	52.255078
3	50.0	272.659570	243.384180	29.275390
4	80.0	295.255312	283.214683	12.040624
5	90.0	302.787226	296.491524	06.295702
6	100.0	310.319140	309.768360	00.550780
7	100.50	310.695735	310.432201	00.033736
8	100.90	310.997012	310.963275	00.033736
9	100.95	311.034671	311.029659	00.005011 A*
10	101.0	311.072331	311.096043	00.023712
11	102.0	311.825522	312.423727	00.598505
12	110.0	317.851054	323.045196	05.194142
13	200.0	385.638280	442.367200	56.728920
14	500.0	611.595700	840.418000	228.82230

Table 1: Height increasing comparison technique

A* It is a graphical point where height difference is 0.005011.
Data can be explained by plotting a graph ------- Increase height Vs height of images



On increasing or decreasing the height of images as per PR, Height difference becomes zero at specific point of the graph. Author named the point --Fusion point. Each sequence has maximum three specific photographic fusion points, depending on the increasing or decreasing rate of images.

(1) Upper fusion point of sequence:-------- Both images are increased.
(2) Middle fusion point of sequence:------ Bigger image decreased and smaller one increased.
(3) Lower fusion point of sequence:------- Both images decreased.
Increasing or decreasing rate of control and exhibit image per unit, after fusion point is 1.00:: 1.00 or same. Length and other measurable characteristic of the images are also having fusion point.
Images of un-identity sequence do not have fusion point, if increased simultaneously.

Height Increased with the relation to each other

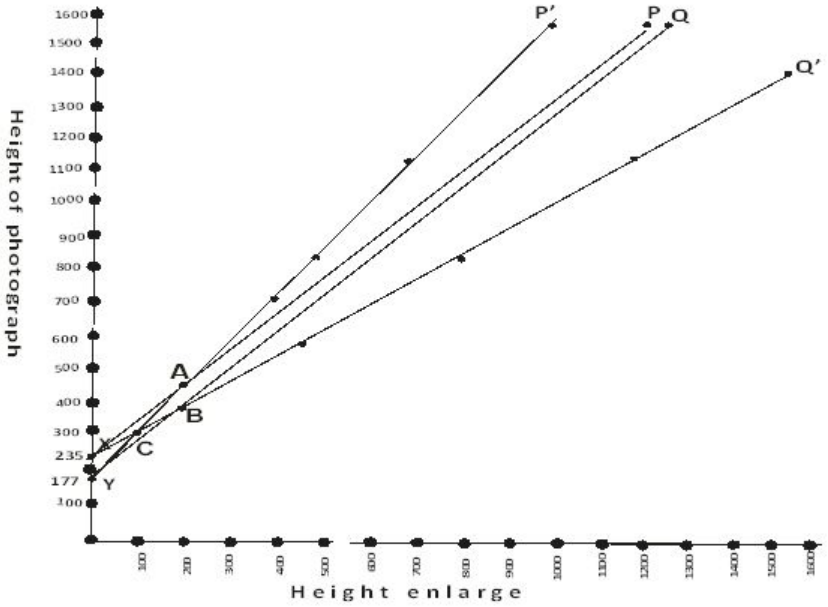
Identity sequence is (1550.0, 235.0, 177.0)
PR (con) = 0.7531914, PR (exh) = 1.3276836

Formula:

(1) Height of image as per increase unit = units increase + hp
(2) Height of image increase as per PR = units increase X PR + hp

S. No	Unit increase	Control (235.0)		Exhibit (177.0)	
		As per increase unit	As per PR	As per increase unit	As per PR
1	100.0	335.0000	310.3191	277.0000	309.7683
2	200.0	435.0000	385.8508	377.0000	442.5367
3	500.0	735.0000	611.5957	677.0000	840.8418
4	800.0	1035.0000	837.5531	977.0000	1239.1468
5	1000.0	1235.0000	988.1914	1177.0000	1504.6836
6	1034.0	1269.0000	1013.7990	1211.0000	1549.8248
7	1034.14	1269.1400	1013.9053	1211.1400	1550.0107
8	1200.00	1435.0000	1138.8296	1377.0000	
9	1300.00	1535.0000	12141488	1477.0000	
10	1500.00	crossed Hs	1364.7871	crossed Hs	
11	1700.00		1515.4253		
12	1745.00		1549.3189		
13	1745.90		1549.9985		
14	1745.91		1550.0043		

Data are explained by plotting a graph ------ height enlarged Vs Height of photograph.



Line XAP indicates increasing height of control as per unit increase.
Line YBQ indicates increasing height of exhibit as per unit increase.
Line YAP' indicates increasing height of exhibit as per photographic relation.
Line XBQ' indicates increasing height of control as per photographic relation.
Line XAP and YAP' crossed each other at point A.
Line YBQ and XBQ' crossed each other at point B.
Point A is fusion of height characteristics, where height of exhibit image is merged with the height of control image. It is mathematical fusion point of height.
Point B is fusion of height characteristics, where height of control image is merged with the height of exhibit image. It is mathematical fusion point of height.
Point C is fusion point of height characteristic, where control and exhibit image merge with each other. It is photographic fusion point of height.
Increasing rate above fusion points is 1.00:: 1.00.
Un-identity sequence does not have photographic or mathematical fusion point if increased simultaneously.

Enlarging or squeezing of image height up to height of other image as per PR

Identity sequence is (1550.0, 235.0, 177.0)
Exhibit image of identity sequence is 58 units smaller than control image.

Formula:

(1) Height of control image = 235.0 – {unit decrease x PR (con)}, PR(con) = 0.7531914
(2) Height of exhibit image = 177.0 + {unit increase x PR (exh)}, PR(exh) = 1.3276836

S. No	Unit increase or decrease	hp(con)	hp(exh)	Height difference
1	00.0	235.000000	177.000000	58.000000
2	10.0	227.468086	190.276836	37.191250
3	20.0	219.936172	203.553672	16.382500
4	25.0	216.170215	210.192090	05.978125
5	27.0	214.663832	212.847450	01.826374
6	27.85	214.023619	213.975988	00.047630
7	27.87	214.008555	214.002541	00.006013 A*
8	28.00	213.910640	214.175140	00.264500

Table 3: A* = (27.87, 214.00). It is photographical middle fusion point of sequence having height difference 0.006 unit.

Un-identity sequence is (1550.0, 235.0, 242.0)
Exhibit image of sequence is 7 units bigger than control image.

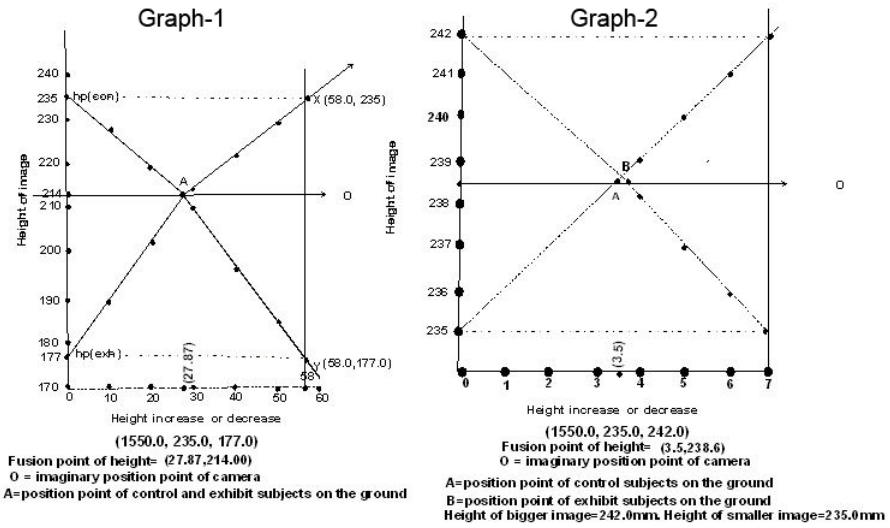
Formula:

(1) Height of control image = 235.0 + { increased units x PR(con) }, PR(con) = 1.0297872
(2) Height of exhibit image = 242.0 – { increased units x PR(exh) }, PR(exh) = 0.9710743

S. No	Unit increase or decrease	Height of control	Height of exhibit	Height difference
1	0.0	235.0000000	242.0000000	7.0000000
2	1.0	236.0297872	241.0289257	4.9991385
3	2.0	237.0595744	240.0578514	2.9982770
4	3.0	238.0893616	239.0867731	0.9974155
5	3.5	238.6042552	238.6012399	0.0030152 B*
6	4.0	239.1191488	238.1157028	1.0034460
7	6.0	241.1787232	236.1735542	5.0051690
8	7.0	242.2085104	235.2024799	7.0060305

Table 4: B* (3.5, 238.60)

Control image increased 3.5 unit and exhibit image decrease 3.5 unit, and both the images is having height 238.60 unit. The subjects of images are having different distance from camera. It is a position situation on the ground having same unit of height. Above data can be explained by Graph 1 and 2.



Graph 1: Increasing the height of exhibit image and decreasing the height of control image as per PR, both control and exhibit image reaches at the point A (27.87, 214.00). It is middle photographical fusion point of image height.
Graph 2: Increasing the height of control image and decreasing the height of exhibit image, control image reached at the point A (3.5, 238.60) and exhibit image reached at point B (3.5, 238.60), having same height, but position point of the subjects on the ground is different.

Relation of image height and distance: Let there be four different images of the subject having height - hp(177), hp(235), hp(242) and hp(311).

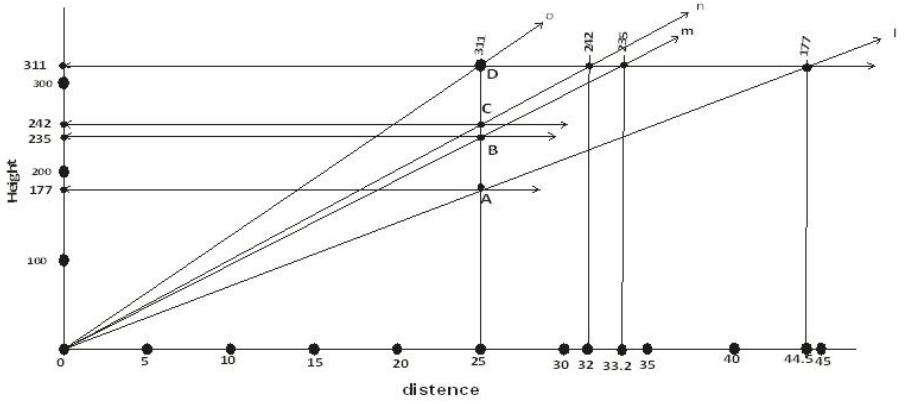


Figure 1: Plotting a graph of distance vs height

X axis represent distance and Y axis represent height of images. All corresponding height lines are parallel to X axis and perpendicular line at the point 25.0 of X axis crosses the parallel lines at point A, B, C and D respectively. Connecting 0.0 distance point with these points, line 0A, 0B, 0C and 0D are formed, indicating relation of distance with different height of images.
(1) hp (177) is related with distance units 44.5 (2) hp(235) is related with distance units 33.2
(3) hp(242) is related with distance units 32.0 (4) hp(311) is related with distance units 25.0

S. No	Height ratio and proportion-P1&P2		Distance ratio and proportion-D1&D2	
1&2	177/235	0.7531:: 1.0000	44.5 /33.2	1.3403:: 1.0000
.	235/177	1.3276:: 1.0000	33.2 /44.5	0.7460:: 1.0000
1&3	177/242	0.7314:: 1.0000	44.5 /32.0	1.3906:: 1.0000
.	242/177	1.3672:: 1.0000	32.0 /44.5	0.7191:: 1.0000
1&4	177/311	0.5691:: 1.0000	44.5 / 25.0	1.7800:: 1.0000
.	311/177	1.7570:: 1.0000	25.0 /44.5	0.5617:: 1.0000
2&3	235/242	0.9710:: 1.0000	33.2/32.0	1.0375:: 1.0000
.	242/235	1.0297:: 1.0000	32.0/33.2	0.9538:: 1.0000
2&4	235/311	0.7556:: 1.0000	33.2/25.0	1.3280:: 1.0000
.	311/235	1.3234:: 1.0000	25.0/33.2	0.7530:: 1.0000

S. No	Height ratio and proportion-P1&P2		Distance ratio and proportion-D1&D2	
3&4	242/311	0.7781:: 1.0000	32.0/25.0	1.2800:: 1.0000
.	311/242	1.2800:: 1.0000	25.0/32.0	0.7812:: 1.0000

Table 5: Multiplying proportionate figure P1 & P2 and D1 &D2 the data will be as under.

Proportionate figure of height (P1 X P2)……Proportionate figure of Distance (D1 X D2)
(1) 0.7531 X 1.3276 = 0. 99981556 0.7460 X 1.3406 = 0.9998638
(2) 0.7314 X 1.3672 = 0.99997008 0.7191 X 1.3906 = 0.9999805
(3) 0.5691 X 1.7531 = 0.99990870 0.5617 X 1.7800 = 0.9998260
(4) 0.9710 X 1.0297 = 0.99982870 0.9638 X 1.0357 = 0.9999840
(5) 0.7556 X 1.3234 = 0.99996104 0.7530 X 1.3280 = 0.9999840
(6) 0.7781 X 1.2800 = 0.99993681 0.7812 X 1.2800 = 0.9999360

Mathematical relative relation between image and distance: (1) Height of subject, images, and distance between subject and camera are mathematically related with each other. P1XP2 = D1XD2 = 1.0 and P1+P2 = D1+D2 (2) Enlarging or squeezing of image height to the size of other one, image will be super imposed obviously plane (angle) of photography and plane (angle) of exposed side must be identical.(3) 2D image is cut out poster of the subject and 3D statue is structural body of the subject.

Mathematical and photographical relation of un-identity sequence:

Sequence (1550.0, 235.0, 242.0).
PR (con) =1.0297874, PR (exh) = 0.9710743, MR (con) = 0.9710743, MR(exh) = 1.0297874
Control image is 7 units smaller than exhibit image.
If control image is enlarged 7.0 units and exhibit image is squeezed 7.0 units, as per PR and MR the data and graph will be as under.

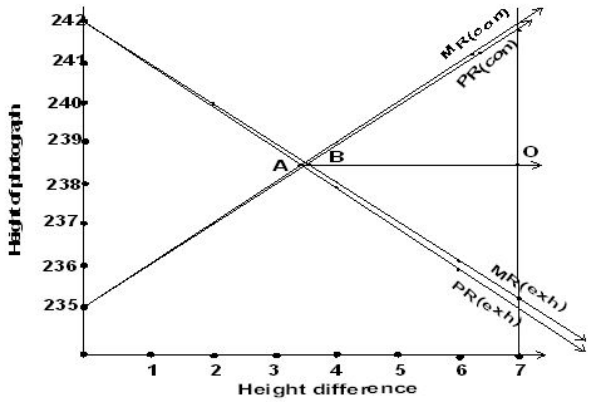
Formula:

(1) Increased height (control) = 235.0 + {enlarged height unit X PR(con) or MR (con)}
(2) Decreased height (exhibit) = 242.0 – {squeezed height unit XPR(exh) or MR(exh)}

S. No	Units enlarged or squeezed	Height of control		Height of exhibit	
		as per PR	as per MR	as per PR	as per MR
1	2	236.942	237.059	239.940	240.050
2	3.5	238.398	238.604	238.601	238.395 *
3	4.0	238.854	239.119	237.880	238.115
4	6.0	240.825	241.178	235.821	236.172
5	7.0	241.797	242.208	234.791	235.202

Table 6: Difference between photographical and mathematical relation is 0.00301595

Plotting a graph of increasing and decreasing height as per PR and MR Vs height of image



Graph 3: Point A and B are separate mathematical fusion point of height. Mathematically PR(con) = MR(exh) and PR(exh) = MR(con). Un-identity sequence is having fusion of height situation. Images can never be fused with each other.

Exhibit image is relatively compared using increasing height comparison technique and increasing rate per unit can be used to point out the person on the fieldwork task.

Supper imposition technique of comparison

Photogram is geometric design of structural body witch is derived from height line, and other different body point lines. Each and every line is relatively proportional to height of the subject. Photograms of identity sequence will supper impose to each other, provided angle of photography and angle situation of the control and exhibit image is same.

Human body and photogram

Human body is bilaterally symmetrical having different limbs (organs), forming front, back, right, and left side. Photograph of individual shows position of limbs and organs, having specific end point, these points are named as body points. Full size standing photographs of an individual, shows natural state and condition of structural body. Distance between two body points always remains relatively proportionate with the height characteristic of an individual as a result any two photograph of the individual can be compared mathematically.

Photograph is having some single body points like head point, nose tip point, center point of mouth, chin point, center point of neck, center point of shoulder line, center point of maximum and minimum girth line, navel point, center point of right and left toe point line. All these points remains on the central vertical line of the image, is the front and only front side (FF-side) of an individual, remaining back, left and right side of body is automatically adjusted and defined with reference to front side.

The distance between two body point can be changed by the subject with some afford or as per requirement, but the structural body limbs comes back to normal and natural positions when requirement is over. Right and left body point of organs are having same distance from central vertical line of front side image, examples are left and right- eye point, shoulder point, ear point, knee point, toe point etc. The body point can be named as (1) head point-A (2) Leg point-B (Centre point of right and left toe point line) (3) Centre of eye (4) near end and far end of eye. (5) near-end and far-end of eye brow. (6) nose tip point (7) upper end and lower end of an ear (8) lip length and its ending or its center (9) chin point (10) neck center point (11) shoulder end point (12) nipple point (13) elbow point (14) knee point (15) toe point (16) belly point (17) maximum and minimum girth-line points (18) buttock point (19) thumb point (20) wrist point (21) ankle point etc.

Height of subject is specific and principal mathematical figure of comparison. The height line of FF side is divided into three regions, according to junctions of movement (neck junction and hip junction), forming three regions. (1) Head – Height of head region is to consider 1/6 unit of total height (2) Middle – Height of middle region is to consider 1/3 unit of total height (3) Leg – Height of leg region is to consider 1/2 unit of total height. Regions wise, the organs are having very limited movement of turning, twisting and bending to the different directions means after completion of requirement it comes back to its normal and natural state of condition. Only deformation of limb is exception of it state. Little turning-bending-twisting is habit formed during life time. The body always remains in balance on the ground by distributing the total weight on right and left foot. Forensic point of view, deformation and habit becomes characteristic of an individual. The above fact can be explained by outer line of photograph and a typical photogram of the front side.

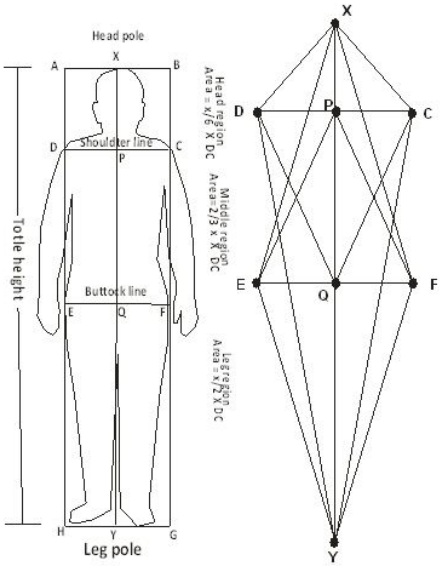


Figure 2: Points X, P, Q and Y are reference points. P and Q are junction points. All are situated on the center line of front side photograph. Line DPC is shoulder point line and line EQF is buttock point line. Connecting any reference point and body point "Photogram" is created. It is biometric and geometric design of the individual. Investigator is free to select any available and appropriate point to create photogram for comparison.

Geological plane and side of the subject

Any position point of subject on plain ground is having mainly four direction lines, indicated by magnetic compass. Angle between

any two nearby direction lines is 90° and four sub directions lines can be obtained and having 45° between any two nearby direction line at this particular position point Considering these direction lines, geological direction plane can be named as north-south (N.S-0), east-west (E.W-0), north- east (N.E-45°) and north-west (N.W-45°). All the plane is having one single common point is position point of subject.

3D structure of the subject is having three measurable parameters namely height, length and breadth. For the purpose of comparison the subject and its 3D object (statue) is also having eight sides are named as Front and only front side (FF), Back and only back side (BB), Left and only left side (LL), Right and only right side (RR), Half front and half right side (FR), Half front and half left side (FL), Half back and half right side (BR), Half back and half left side (BL).Photograph is 2D image of subject. Logically it is true that height parameter of image is directly proportional with the height parameter of statue from any distance and length of image is indirectly proportional to the height of statue depends on the angle of photography and exposed side of statue.

Height and length relation of the image

Considering the subject is turning clockwise, without changing the position point of the ground. Length of front side image will be reduced according to angle turned by the subject, 90° of clockwise turn converts front side into left or right side. It is the depth of 3D object from front side. Theoretically 360 different angled photographs can be snapped without changing the position point by clockwise or anticlockwise turn.

Length unit of front side decreased as per the angle turned by the subject and it is ninetieth part of length per theta. 90° of turn convert front side length in to right or left side length, means length of photograph is sum of fractionated length of front and right or left side according to angle of turn. Height of image remains same as distance is constant. Front and back side are opposite side of each other, having same unit of length, so as right and left side.

It is concluded that any vertical line (height) of image is having specific proportional relation with height of subject and horizontal line (length) of image is sum of fractionated length and breadth of subject. As a result super imposition of two images of the same subject can mathematically be proved, provided both control and exhibit image is having same angle of photography and geological plane of the front side.

Angle of photography

Geological direction plane of two position point of the subject and photographer can be explained by the figure below.

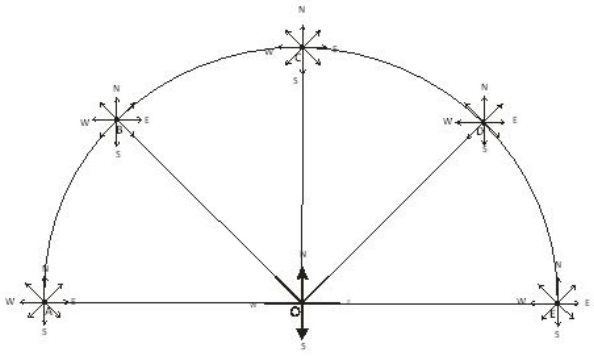


Figure 3: Angle of photography

O is position point of photographer (camera) on the plain ground surface that facing to north and position point of subject may be either point A, B, C, D or E, facing to south. The different possibility of arrangement are formed namely OA, OB, OC, OD and OE. Only OC arrangement is having same geological direction plane (N.S-0) for subject and photographer, remaining arrangement are having parallel north-south direction plane as a result, angle of photography is formed. It is an angle between geological north-south direction plane and front side plane of photographer, it may be 0°, 45° or 90°. The position point of subject is either to front side or to right hand side or left hand side of photographer.

Angle of situation

First initial basic situation of photographer and subject on the ground is having 0° angle of photography and 0° angle of situation, means both are facing to each other having same geological direction plane. Second situation is angle turned by the subject either clock wise or anti-clock wise without changing the position point. 45° degree of turn will be exposed either FL or FR side, 90 degree of turn will be exposed RR or LLside,135 degree of turn will be exposed BL or BR side and 180 degree of turn will be exposed only BB side. Front side plane of photographer (camera) will be always over lapping to one of the side plane of subject, while snapping.

Considering the subject is facing to either north, south, east, west, north-east 45, north-west 45, south-east 45, or south-west 45. Front side and Back side are opposite side to each other and both are having the same geological direction plane. Only one of these two opposite side is facing to the front side of photographer (camera). Simultaneously RR & LL, FR & BL, and FL & BR are opposite side to each other.

Data of the above fact are as per chart below.

S. No	Exposed Side of subject	FF side direction plane of subject	Subject is facing to direction	Angle of situation	Angle turn subject
1	Front and only front side… FF	(N.S-0)	South	0°	0°
2	Half front and half left……. FL	(N.W-45)	south-east.45	45°	45°
3	Left and only left side…….. LL	(E.W-0)	East	90°	90°
4	Half back and half left…… BL	(N.E-45)	north-east.45	135°	135°
5	Back and only back side… BB	(N.S-0)	north	0°	180°
6	Half front and half right….FR	(N.E-45)	south-west.45	45°	45°
7	Right and only right side.. RR	(E.W-0)	West	90°	90°
8	Half back and half right… BR	(N.E-45)	north-east.45	135°	135°

Table 7: Data of the above fact are as per chart above

Factor that influences the exposed side of subject are as below.
(1) Clock-wise or anti-clockwise turned by the subject from 1st initial situation
(2) FF side- facing direction of subject.
(3) Facing direction plane of camera lens.

Desired angle and posture of image can easily be obtained in the premises of laboratory by specific arrangement of camera and subject. A video clip of revolving stage photography is having 360 different angled postures of the body to be compared with exhibit image.

Field work photography

Photographer is using maximum benefit of his idea to get desired result by fixing the position of camera and the object. Desired angled image (photograph) can be obtained with the help of camera, and magnetic compass having two arrow head indicator that can be pointed to any direction.

Angle of situation and snapping of the photograph: On the field it is obvious that subject may have any angle of 2nd situation. Photographer has to select his point of position on the ground by focusing camera and setting of direction indicated by arrows of magnetic- compass.

Step 1: Photographer has to select the distance, so that the subject appears to the specified square area on the camera screen.
Step 2: Observing facing direction of the subject, he himself has to face that plane of direction with his camera and magnetic compass so that facing direction plane of both subject & photographer becomes parallel to each other. Angle of situation is to be noted. First arrow head indicator is to be fixed to this direction. Second arrow head indicator is to be fixed by calculating the angle that converts angle of situation and angle photography in to 45° or 90°
Step 3: The photographer has to change his position point on the plain ground surface as per the direction plane indicated by second indicator and to select next position point on the ground.
Step 4: Photographer has to snap when the subject appears into the specified square area of the camera.
Above things can be explained by the figure below.

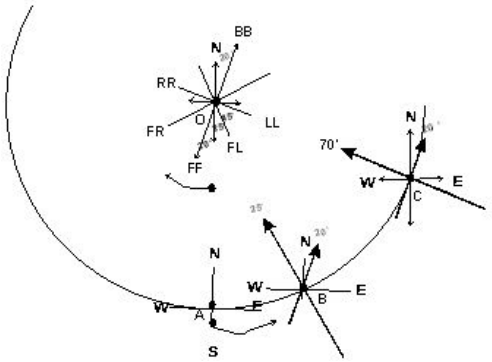


Figure 4: Angle of situation and snapping of the photograph

Step 1 & 2: OA is the distance between subject and photographer. Considering O and A is first and second arrangement position of subject and photographer on the plain ground, Subject is facing to south and photographer is facing to north is first situation (facing direction plane is NS-0).The subject has turned clockwise as a result his facing direction became SW-20. After observing facing direction of the subject, photographer has to turned anti clock-wise so that facing direction plane becomes parallel to each other. Photographer will fix first indicator to his facing direction plane, that compass is indicating NE-20°.The second indicator is to be fixed to NW-25°, (25+20=45) so that angle of photography converts in to 45°.

Step 3 & 4: The photographer has to change his point of position to B, arrangement situation will be OB. The subject is facing to SW-20°, but the angle of situation and angle of photography is 45°. The side of the subject that exposed will be FL side. If 2nd indicator is fixed to NW-70°, Photographer has to change his position at point C, angle of photography and angle of situation will be 90°, side of subject that exposed will be LL side. The possibility of image height obtained from the field may be same, bigger or smaller than height of control image.

Fix distanced photographic height of the subject and photographic unit of length

Height characteristic of the subject is generally measured in unit of feet & height of image is measured in unit of millimeter. Image of the person is having height that is relative and proportional to the height of subject that varies with the distance. The images are also related with each other. Two images are related with each other having ratio data of height P1XP2=1.0 and ratio data of distance is D1XD2 = 1.0. Condition of distance can be solved by clicking the subject from constant distance and condition of height can be solved mathematically as per data obtained.

Mathematically if A is proportional to B, and multiplying x with both the figure, Ax will be proportional to Bx and equation of proportion will be A α B = Ax α Bx. Considering A is height unit of subject or object and B is height unit of its image. If a foot-rule of 300.0 mm is having image height 20.0 mm, multiplication of 5.0 with height data of control object and height data of image will be 300.0 x 5.0 = 1500.0 and 20.0 x 5.0 =100. That is foot-rule of 1500.0 mm will have image height 100.0 mm, at that same situation of distance. Author describes 300.0 mm foot-rule as flexible control.

Height unit of subject or object and height unit of image are relatively proportional to each other, with reference to distance having relative constant (x). If a foot-rule of 300.0 mm is snapped from the distance of 10.0 feet and is having image height of 20.123 mm. x = 14.9083138697.

The equation of proportion will be 300.000:: 20.123 = 14.9083138697:: 1.0000000000.
Considering unit of image length is compact unit. It is named as relative-proportional-photographic unit (rpp.x mm).

Conclusion

(1) Each and every subject or object is having relative proportional photographic image height related to distance.
(2) If foot-rule is snapped along with the subject and image height of subject is X time bigger than image of foot-rule, means the height of subject is X feet related to that distance.
(3) Unit of photographic length is rpp.x mm.
(4) Fixed distance is, the distance that the flexible control foot-rule and subject is having same height.
(5) Height of subject will be addition or subtraction from flexible data of foot rule (control) height and image height data of subject.

Factors that affect the result and precautionary measures are as under:-
(1) Ratio data: Relative relation of image height and relative relation of distance can mathematically described only by numeric figure and its ratio proportion. Possibility of having same ratio data even with different numeric figure that affects the result.
(2) Angle of back-ground depth: Uplifting or tilting the direction plane of camera lens will not measure the correct value of image height. Direction plane of camera lens and ground level plane should be parallel to each other. It is good to keep the camera on tripod-stand having distance of about 2.5 feet from the ground level.
(3) Personal error in measurement of image height: The photographic unit of length (rpp.x mm) is compact millimeter unit of length and error of a single unit in measurement of image height, reflect the result. Height of image is length between two body points, namely head point and toe point. Instead of front side image of the subject, left or right side image is recommended to measure the height.
(4) Fixed distance photographic height of subject in fractions of unit is the additional characteristic of identity.
Height of subject is calculated as under.
Data of images are as under and considering 304.8 mm = 1.00 feet.
Measured height of subject (Him) is 1690.0 mm = 5.545 feet
Available height sequence is (300.000, 23.324, 120.932)
Ratio of control and exhibit image is 23.324:: 120.932 = 1.0000000:: 5.1848739
Exhibit image is 5.1848739 times bigger than control image. Height of subject is 5.1848739 times bigger than image height of control at this particular distance condition.
Multiplication of 5.1848739 with image height and height of object, a new sequence will be obtained
= (300.000 x 5.1848739, 23.324 x 5.1848739, 120.932)
= (1555.4621700, 120.9319988, 120.9320000)

Calculated height of subject:

1555.4621700 + 120.9320000 = 1676.39417 rpp.x mm = 5.4999808 rpp.x feet Or 1555.4621700 – 120.9320000 = 1434.53017 rpp.x mm = 4.7064638 rpp.x feet

Measured height is 1690.0 mm (5.545 feet).Correct height of the subject in fraction of unit is 5.4999808 rpp.x feet is equivalent to 5.4999808 feet at the fusion point of height.

Difference of calculated height and measured height is 0.0450192 feet.

S. No	Measured height of subject	Available sequence	Result			
			Result in rpp.x mm		Result in rpp.x feet	
(1)	Hs (Him)	(1) (300.000, 23.324, 120.932)	1676.39417	1434.53017	5.49998	4.70646
	1690.0 mm	(2) (300.000, 28.538, 143.940)	1657.08037	1369.20037	5.43661	4.49212
	(5.545 feet)	(3)(300.000, 43.832, 228.346)	1706.81187	1418.44717	5.59977	4.65369
	Average =		1680.09547	1407.39257	5.51212	4.61742
	Calculated height with the aid of light beam is 5.51212 feet or 4.61742 feet. Minimum difference between measured and calculated height = 0.03288 feet. Calculated height with the aid of light beam is 5.51212 feet.					
(2)	Hs (Ash)	(1) (300.000, 13.168, 65.908)	1580.57800	1435.64340	5.18500	4.71011
	1620.0 mm	(2) (300.000,58.321, 276.102)	1696.35542	1144.15142	5.56547	3.75377
	(5.315 feet)	(3)(300.000 40.991, 195.800)	1628.79748	1237.19748	5.34382	4.05904
	Average =		1635.24363	1272.33076	5.36476	4.17430
	Calculated height with the aid of light beam is 5.36476 feet or 4.17430 feet. Minimum difference between measured and calculated height is 0.0497 feet. Calculated height with the aid of light beam is = 5.36476 feet.					
(3)	Hs (Pin)	(1) (300.000, 16.601, 80.517)	1535.55585	1374.521953	5.03791	4.50958
	1580.0	(2) (300.000, 26.634, 130.506)	1600.49924	1339.48724	5.25098	4.39464
	(5.183 feet)	(3) (300.000, 28.257 134.305)	1560.19946	1291.58946	5.11876	4.23749
	Average =		1565.41818	1335.19955	5.13588	4.38057
	Calculated height with the aid of light beam is 5.13588 feet or 4.38057 feet. Minimum difference between measured and calculated height of subject =0.0471. Calculated height with the aid of light beam = 5.13588 rpp.x feet.					
(4)	Hs (Aru)	(1) (300.000, 35.297, 162.072)	1539.57150	1215.42260	5. 05108	3.98760
	1540.0 mm	(2) (300.000, 20.358, 93.484)	1471.08494	1284.11694	4.82639	4.21298
	(5.053 feet)	(3) (300.000, 42.583, 195.483)	1572.68047	1181.71447	5.15971	3.87701
	Average =		1527.77897	1227.08467	5.01239	4.02586
	Calculated height with the aid of light beam is 5.01239 feet or 4.02586 feet. Minimum difference between measured and calculated height of subject =0.0471. Calculated height with the aid of light beam = 5.01239 feet.					
(5)	Hs (Vib)	(1) (300.000, 23.898, 132.698)	1798.50266	1533.10666	5.90059	5.02987
	1490.0 mm	(2) (300.000, 31.103, 173.435)	1846.28006	1499.41006	6.05734	4.91932
	(4.937 feet)	(3) (300.000, 19.184, 106.529)	1772.43287	1559.37487	5.81506	5.11605
	Average =		1805.73853	1530.63053	5.31198	5.02174
	Calculated height with the aid of light beam is 5.31198 feet or 5.02174 feet. Minimum difference between measured and calculated height of subject = 0.08474feet. Calculated height with the aid of light beam = 5.01239 feet.					

Table 8: Fixed distance photographic foot-rule height of five subjects is calculated thrice, the result is as above

Comparison and identification

Photograms of FF, BB, RR and LL side of the subject are to be compared by all the three procedural techniques for bodily structural identification. The subject is having same height as control subject, but do not have same body point data can all so be differentiated using increasing height technique and supper imposition technique. Forensic case of alteration or manipulation of image can be proved in the premises of laboratory using revolving stage photography to obtain the correct posture of the control image as identity sequence turns into un-identity sequence during manipulation process.

Comparison equations are as under.
(1) hp(con) x PR(con) x f = hp (exh) x PR(exh) x F --------- (EPR)
(2) hp(con) x MR(con) x f = hp(exh) x MR(exh) x F ------- (EMR)

Identity sequence (1550.0, 235.0, 177. 0)

(a) Body point data of RR side and the equations are as under:
Height of control image X factor of height sequence (6.5974468) = Height of control subject. Equation of photographic relation is same as equation of mathematic relation. (EPR) = (EMR)
(1) X-Y height sequence (1550.0, 235.0, 177,0):
Data: PR(con) = MR(exh) = 0.7570521, MR(con = PR(exh) = 1.3275835, F = 6.5974468, f = 8.7570521
235 x 0.7570521 x 8.7570521 = 177 x 1.3275835 X 6.5974468.
1549.9998078 =1549.99995253
(2) X-nose point sequence is (235.0, 28.0, 21.0)
Data: PR(con) = MR(exh) = 0.7500000,MR(con) = PR(exh) = 1.3333333, F = 8.3928571, f = 11.1904751
28.0 x 0.7500000 x 11.1904751 = 21.0 x 1.3333333 x 8.3928571.
234.9999981 = 234.9999929.
6.5974468 X 234.9999981 = 6.5974468 x 234.9999929
1550.3999854 = 1550.399951
(3) X- cheek point sequence is (235.0, 35.0, 28.0,)
PR (con) = MR(exh) = 0.80000000, MR(con) = PR(exh) = 1.2500000, F = 5.7142857, f = 8.3928571
235.0 x 0.8000000 x 8.3928571 = 28.0 x 1.2500000 x 5.7142857.
234.9999980 = 234.9999995.
6.5974468 x 234.9999980 = 6.5974468 x 234.9999995.
1550.3999848 =1550.39996501
(4) P-belly point sequence is (235.0, 59.0, 45.0,)
PR (con) = MR(exh) = 0.7527118, MR(con) = PR(exh) = 1.3111111, F = 3.9830508, f = 5.2222222
59.0 x 0.7527118 x 5.2222222 =45.0 x 1.3111111 x 3.9830508.
234.999979 =234.9999952.
6.5974468 x 234.999979 = 6.5974468 x 234.9999952.
1550.3998594 = 1550.39996633
(5) Y- buttock point sequence is (235.0, 121.0, 90.0,)
PR (con) = MR(exh) = 0.7438015, MR(con) = PR(exh)=1.3444444, F=1.9421487, f= 2.5111111
121.0 x 0.7438015 x 2.5111111 = 90.0 x 1.3444444 x 1.9421487.
234.9999822 = 234.9999849.
6.5974468 x 234.9999822 = 6.5974468 x 234.9999849.
1550.3998805 = 1550.3998983

(b) Height equation of exhibit image:
hp(con) x PR(con) x f = hp (exh) x PR(exh) x F
{hp (con) x PR(con) x f} ÷ {PR (exh) x F} =hp (exh).
(235.0 x 0.7570521x 8.7570521) ÷ (1.3275835 x 6 .5974468) = 176.9999821

(c) Body point data of FF side and equations of comparison are as under:
(1) X-lower ear point sequence is (235.0, 31.0, 24.0)
Data: PR(con)=MR(exh)=0.7741935,MR(con)=PR(exh)=1.2916666, F= 7.5806451, f= 9.7916666
31.0 x 0.7741935 x 9.7916666 = 24 x 1.2916666 x 7.5806451.
234.999983 = 234.9998597.
6.5974468 x 234.999983 = 6.5974468 x 234.9998597.
1550.3998858 = 1550.3990723
(2) X-shoulder point sequence is (235.0, 47.0, 35.0)
Data: PR(con)=MR(exh)=0.7446808, MR(con)=PR(exh)=1.3428571, F=5.0000000, f= 6.7142857
47.0 x 0.7446808 x 6.7142857 = 35.0 x1.3428571 x 5.0000000
234.9999833=234.9999925.

6.5974468 x 234.9999833 = 6.5974468 x 234.999925.
1550.3998878 = 1550.3995031
(3) Q-shoulder point sequence is (235.0, 83.0, 63.0,)
Data: PR(con)=MR(exh)=0.7590361, MR(con)=PR(exh)=1.3174603, F= 2.8313253, f= 3.7301587
83.0 x 0.7590361 x 3.7301587 = 63.0 x 1.3174603 x 2.8313253.
234.9999842 = 234.9999967.
6.5974468 x 234.9999842 = 6.5974468 x 234.9999967.
1550.3998937 = 1550.39997622
(4) P-buttock point sequence is (235.0, 82.0, 62.0,)
Data: PR(con)=MR(exh)=0.7560975, MR(con)=PR(exh)=1.3225806, F=2.8658536. f = 3.7903225
82.0 x 0.7560975 x 3.7903225 = 62.0 x 1.3225806 x 2.8658536
234.9999750 = 234.9999871
6.5974468 x 234.9999750 = 6.5974468 x 234.9999871
1550.3998330 = 1550.3999128
(5) Y-buttock point sequence is (235.0, 123.0, 92.0,)
Data: PR(con)=MR(exh)=0.7479674, MR(con)=PR(exh)=1.3369565, F= 1.9105691, f= 2.5543478
123.0x 0.7479674 x 2.5543478 = 92.0x 1.3369565 x 1.9105691.
234.9999725 = 234.9999954.
6.5974468 x 234.9999725 = 6.5974468 x 234.999954.
1550.3998165 = 1550.39969451
(6) Y-shoulder point sequence is (235.0, 196.0, 149.0,)
Data: PR(con)=MR(exh)=0.7602140, MR(con)=PR(exh)=1.31543624, F= 1.1989795, f =1.5771812
196.0 x 0.7602140 x1.5771812=149.0 x1.31543624 x1.1989795.
235.0030648 = 234.9999819.
6.5974468 x 235.0030648 = 6.5974468 x 234.9999819.
1550.42021785= 1550.3998785

Mathematically FF, BB, LL, FR, FL, BR, and BL side of exhibit subject are compared with respective side of control subject. Body points of images are directly and indirectly proportional with the height unit of control subject. Height of exhibit image as per equation is 176.9999821 mm.

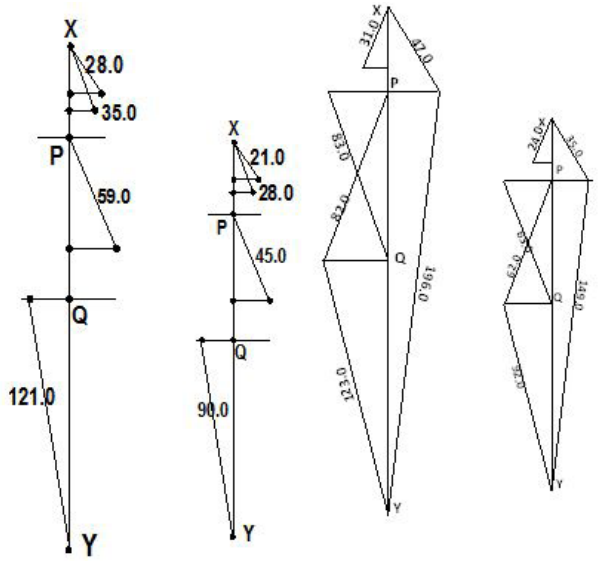


Figure 5: Photogram of RR side and FF side of sequence

Increasing of height as per PR after fusion point

The sequence is having upper fusion point of height is (110.95, 311.03) having height difference 0.005mm. The sequence is having middle fusion point of height is (27.87, 214.00) having height difference 0.006mm.Control and exhibit image increases at the rate of 1.00:: 1.00 after fusion point and reaches up to the height of control subject at the same time. The subjects are having height of 1550.399 rpp. x mm = 1550.399 mm = 5.08661089238 feet. Other body points of sequence are also having same fusion points as height characteristic.

Supper imposition comparison of photograms: All the photogram of sequence fused or supper imposed with each other.

It is concluded that the exhibit image is of the control subject.

Un-identity height sequence is (1550, 235.0, 242.0)

Equation of photographic relation and equation of mathematical relation is not same (EPR ≠ EMR)
Mathematical calculation of body points are as under.
(1) X-Y height sequence (1550.0, 235.0, 242.0)PR(con) = MR(exh) =1.0297872 , PR (exh) = MR(con) = 0.9710743, F = 6.5957446, f = 6.4049586
235.0 x 1.0297872 x 6.4049586 = 242.0 x 0.9710743 x 6.5957446 Data:
1549.99992996 ≠ 1449.99985304 ---------- (EPR)
235.0 x 0.9710743 x 6.4049586 = 242.0 x 1.0297872 x 6.5957446
1461.62731192 ≠ 1643.71563397 ---------- (EMR)
(2) X-nose point sequence is (235.0, 29.0, 30.0)
Data: PR(con) = MR(exh)=1.0344827, PR(exh) = MR (con)=0.9666666, F=8.1034482, f=7.8333333
(1) 29.0 x 1.0344827 x 7.8333333 = 30.0 x 0.9666666 x 8.1034482
234.9999865 = 234.9999815 ---------- (EPR)
(2)29.0 x 0.9666666 x 7.8333333 = 30 x 1.0344827 x 8.1034482
227.1666488 ≠ 243.1032689 ---------- Equation (EMR) is not correct
(3) X-cheek point sequence is (235.0, 35.0, 37.0).
Data: PR(con) = MR(exh)= 1.0571428, PR(exh)= MR(con)= 0.9459459, F= 6.7142857, f=6.3513513
(1) 35.0 x 1.0571428 x 6.3513513 = 37.0 x 0.9459459 x 6.7142857
234.9999853 = 234.9999880 ---------- (EPR)
(2) 35.0 x 0.9459459 x 6.3513513 = 37.0 x 1.0571428 x 6.7142857
210.2812152 ≠ 248.4285559 ---------- Equation (EMR) is not correct.
(4) P-belly point sequence is (235.0, 58.0, 63.0)
Data=PR (con) = MR(exh) = 1.0862068, PR(exh) = MR(con) =0.9206349, F= 4.0517241, f = 3.7301587
(1) 58.0 x 1.0862068 x 3.7301587 = 63.0 x 0.9206349 x 4.0517241
234.9999772 = 234.999925 ---------- (EPR)
(2) 58.0 x 0.9206349 x 3.7301587 = 63.0 x 1.0862068 x 4.0517241
199.1786283 ≠ 281.6382691 ----------Equation (EMR) is not correct.
(5) Y-Buttock point (235.0, 120.0, 126.0)
Data= PR (con) = MR (exh)= 1.0500000, MR(con)= PR(exh)= 0.9523809, F= 1.9583333, f = 1.8650793
(1) 120.0 x 1.0500000 X 1.8650793 = 126.0 x 0.9523809 X 1.9583333
234.9999918 = 234.9999830 ---------- (EPR)
(2) 120.0 x 0.9523809 X 1.8650793 = 126.0 x 1.0500000 x 1.9583333
213.1519082 ≠ 259.0874955 ----------Equation (EMR) is not correct.
(6) Height of exhibit image: hp (exh)={hp(con) x PR(con) x f} ÷ {PR (exh) x F}
= {235.0 x 1.0297872 X 6.5957446} ÷ {0.9710743 x 6.4049586}
= 256.6317592 mm---------- ----------As per (EPR)
= {hp(con) x MR(con)x f} ÷ {MR(exh) x F}
= {235.0 x 0.9710743 x 6.4049586} ÷ {1.0297872 x 6.5957446}
= 215.1916094 mm---------- ----------As per (EMR)
Calculated height of exhibit image using EPR and EMR is 256.6317592 and 215.1916094 are not correct. Actually, it is 242.0 mm.

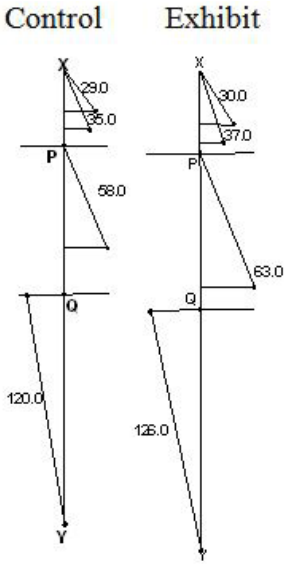


Figure 6: Photogram of control and exhibit image

Mathematically LL, BB, FR, FL, BR, and BL side of exhibit subject are also not comparable with respective side of control subject. Photograms are not fused with each other. The images are having a fusion of height situation, but not the fusion point. If control and exhibit images increased as per MR both will reach at destination with different time.

Fifty subjects are being snapped twice from different distance with the same angle of photography and same angle of situation. The subjects are having age between twenty to seventy years. Height range of subjects is between 1400.0 mm to 1800.0 mm. Time gaps between two snap is few seconds. Two to three body points are selected from each region of the standing posture. Front side standing photograph of the subject is considered as normal and natural posture of the body. Ideal height of camera from the ground level is 2.5 to 3.0 feet, and direction plane of camera lens should be parallel with the ground level plane. 97.0 % of body point characteristic of the same person are comparable up to third digit after decimal points.

FF side photographs of the five subjects is used as control and front side photograph of same person is selected from album having time gape of about a year, used as exhibit image, with consideration that the angle of photography and angle of situation is 0° degree. Both images are comparable. All the subjects are identified by their physical structural body points.

It is concluded that the photogram technique of comparison is mathematical process of addition and multiplication of numeric figure. The result is obtained in the fractions of millimeter. Factor that affects the result are angle of photography, angle of front side direction plane, region wise unpredicted turning, twisting and bending of the body limb from normal and natural posture. It is advisable to select 2-3 un-covered body points, even though the thick ness of cloths is having negligible error while measuring the body point length from the distance. All these factors can be rectified by using camera along with magnetic compass.

Height increasing ratio after fusion point and fusion of height situation

Identity sequence: The sequence (1500.0, 235.0, 177.0) is having upper fusion point of height (110.96, 311.034). Height difference between images is 0.005011 units. Images will be increased at the same rate of 1.00:: 1.00 and reach up to the destination at the same time. The subject of exhibit image is having height 1549.99995253 mm, and height of image is 176.9999821 mm.

Un-identity sequence: Images of un-identity sequence never fuse with each other, as exhibit image of sequence do not have indirect relation with height of control subject. It is having fusion of height situation that is images is having same height unit but the distance between subject and camera is different on the plain ground.
The sequence (1550.0, 235.0, 242.0) is having fusion of height situation (119.22, 357.77). Height difference per unit is 0.058, reaches up to the destination at the different time. Ratio of increasing height will be as per height difference at this situation.

Altered or manipulated image is compared and identified

Alteration or manipulation of the image can be proved by photogram technique. A person came with complained that, this is not my photograph. "I have never posed like this image. It only appears as my image". Investigator has to create a control photogram according to angle of photography, angle of situation and posture as per exhibit image with co-operation of the person, using try, and error method. Video clip of revolving stage photography will be useful for such creation.

Experimental purpose, manipulated image is created by the combining head region of subject having different height and the rest of the body parts are of the subject having height 1550.0 mm, Angle of photography and side plane of control and exhibit image is identical. Logical point to identify manipulated image are
(1) The image height is definitely be altered but not the height of subject as a result identity sequence turned into un-identity sequence.
(2) Body points of control and exhibit image will not be fuse with each other at fusion point of height.

Available height of control is 258.0 rpp.x mm and height of exhibit image is181.0 rpp.x. The subject is having RR side. Data of photogram are as under.

Control image photogram:
(1) XY- height characteristic ---- 258.00 rpp. x mm
(2) X-nose point -------- 34.80 rpp.x mm
(3) X-cheek point ---------- 41.80 rpp.x mm
(4) P-belly point--------- 76.60 rpp.x mm
(5) Shoulder-wrist point---------- 95.60 rpp. x mm
(6) Y-Buttock point-----125.60rpp.x mm

Exhibit image photogram:
(1) XY- height characteristic ---- 181.00 rpp. x mm
(2) X-nose point ------- 26.80 rpp.x mm
(3) X-cheek point ----------29.00 rpp.x mm
(4) P-belly point---------42.60 rpp.x mm
(5) Shoulder-wrist point---------- 59.80 rpp. x mm
(6) Y-Buttock point-----93.80 rpp.x mm

Height of control image (258.0) is squeezed up to the height of exhibit image (181), result is as under				
S. No	**Characteristic of control image**	**Squeezed height**	**characteristic of exhibit image**	**Difference**
1	Height (258.00)	181.00	181.00	---- nil----
2	X-nose (34.80)	24.80	26.80	02.00*
3	X-cheek (41.80)	31.10	29.00	02.10*
4	P-belly(76.60)	54.50	42.60	11.90*
5	shoulder- wrist (95.60)	68.20	59.80	08.40*
6	Y-buttock (125.60)	89.50	93.80	04.30*
Height of exhibit image (181.0) is increased up to the height of control image (258), result is as under				
S. No	**Characteristic of control image**	**Squeezed height**	**characteristic of exhibit image**	**Difference**
1	Height (181.00)	258.00	258.00	---nil---
2	X-nose (26.80)	36.00	34.80	01.20*
3	X-cheek (29.0)	39.70	41.80	02.10*
4	P-belly (42.60)	61.30	76.60	15.30*
5	shoulder-wrist (59.80)	86.10	96.60	10.50*
6	Y-buttock(93.80)	130.90	125.60	05.30*

*Body point characteristic of exhibit image and control image are not comparable.

Table 9: Comparison by mathematical fusion of height method

Comparison by fusion of height method

Ratio: Control :: Exhibit = 258.0 :: 181.0 = 1.4254143 :: 1.0000000
Control > Exhibit.
1.0000000 :: 0.7015503
PR(con)= 0.7015503
PR(exh) = 1.4254143
Let A is the unit that increased by control and exhibit as per photographical relation.
hp(con) + PR(con) X A = hp(exh) + PR(exh) X A.
258.0 X 0.7015503 A = 181.0 X 1.4254143 A.
258.0 – 181.0 = (1.4254143 – 0.7015503) A.
77.0 = 0.7238640A.
106.373573 = A
258.0 X 0.7015503 X 106.373573 = 181.0 X 1.4254143 X 106.373573.
332.6264120502 = 332.626412096
Fusion point of height characteristic is (106.373573, 332.6264120).

Image of control (258.0) and exhibit (181.0) is to be practically increased up to the height of fusion point - 332.62 rpp.x mm. Images are further increased 100.00 rpp.x mm.

There will be two possibilities
(1) Images of identity sequence will have height of 432.62 units.
(2) Images of un-identity sequence will have different height.

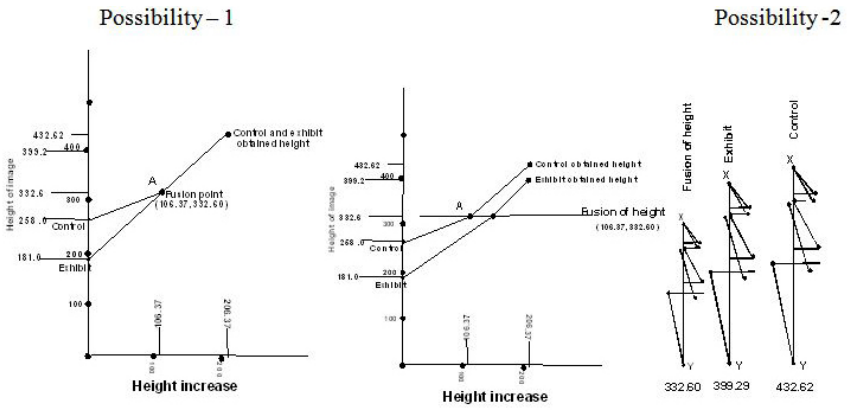


Figure 7: Exhibit image is tempered image

Result is as under.
(1) Control image obtained height of 432.62 mm and exhibit image obtained height of 399.29 mm
(2) Images are not increased at the rate of 1.00:: 1.00 after fusion of height characteristic.
(3) Sequence having control image height 258.0 rpp.x mm and exhibit image height 181.0 rpp,x mm is un-identity sequence.

Comparison of images of the subjects having same height, in unit of millimeter but not the other body point: For the purpose of experiment author has selected RR side photographs and the images having height identity sequence (1550.00, 234.96, 177.11), Length of smaller one image is altered and increased 5.50 rpp mm, means the belly size of exhibit subject is increased maximum about 1.0 to 2.0 millimeter, considering photographic unit (rpp.x mm) is compact millimeter unit of length.

Data of images are as below.
(1) Height and length of control image…… hp (con)=234.96 mm and lp (con)= 54.50 mm
(2) Height and length of exhibit image…… hp (exh)=177.11mm and lp (exh) =40.89 mm
(3) Altered length characteristic of exhibit image…40.89 + 5.50 = 46.39 mm.
(4) Height and length of altered exhibit image… hp (exh) =177.11 and lp (exh) = 46.39 mm
(5) Sequence of height characteristic……. (1550, 234.96, 177.11)
(6) Sequence of length characteristic……. (234.96, 54.50, 40.89)
(7) Sequence of altered length characteristic ….(234.96, 54.50, 46.39)

(a) Mathematical comparison:
(1) Sequence of height is (1550, 234.96, 177.11)
PR(con) =0.75378788, PR(exh)= 1.32663317 F=6.59686755 f= 8.75162328
Formula:---------- hp (con) X PR (con) X f = hp (exh) X PR (exh) X F.
234.96 X 0.75378788 X 8.75162328 = 177.11 X 1.32663317 X 6.59686755.
1549.99981 = 1549.99991---------- (a)
(2) Sequence of length is (234.96, 54.50, 40.89)
PR(con)= 0.75027523, PR(exh)= 1.33284422, F = 4.31119266, f= 5.7461482
Formula = lp (con) X PR (con) X f = lp (exh) X PR (exh) X F.
54.50 X 0.75027523 X 5.7461482 = 40.89 X 1.33284422 X 4.31119266.
234.959991 = 234.959994---------- (b)
(3) Altered length sequence is (234.96, 54.50, 46.39)
PR(con) =0.75027523, PR(exh)= 1.33284422, F=4.31119266, f= 5.7461482
Formula: lp (con) X PR (con) X f = lp (exh) X PR (exh) X F.
54.50 X 0.75027523 X 5.7461482 = 46.39 X 1.33284422 X 4.31119266.
234.959991 ≠ 266.563808 ….It is not correct. ---------- (c)
It is concluded from the result of (a), (b) and (c) Subject of altered exhibit image is having different size of belly.

(b) Comparison by increased height after fusion point:
(1) Sequence …(1550, 234.96, 177.11)
PR(con)= 0.75378788, PR (exh) = 1.32663317
Fusion point of the sequence:
A is the unit to be increased by control and exhibit.
hp (con) + PR (con) X A = hp (exh) + PR (exh) X A.
234.96 + 0.75378788 A = 177.11+ 1.32663317 A.
234.96 – 177.11 = (1.32663317 – 0.75378788) A.
57.85 = 0.5728453A.
100.98 = A.
234.96 + 0.75378788 X100.98 = 177.11+ 1.32663317 A.
311.077492 = 311.07341
Fusion point of sequence is (100.98, 311.07)

Photogram of control image, exhibit image, and altered exhibit image, are practically increased up to fusion point of height--311.07rpp.xmm. The images are again increased 100.0 units subsequently twice.

	Control and exhibit	Altered-exhibit	Difference
Height characteristic ----	311.07 rpp.x mm	311.07 rpp.x mm	---- nil----
Length characteristic -------	72.15 rpp.x mm*	81.47 rpp.x mm	9.32 rpp.x mm**
Height of photogram is increased 100.00 units			
Height characteristic ----	411.07 rpp.x mm	411.07 rpp.x mm	---- nil----

	Control and exhibit	Altered-exhibit	Difference
Length characteristic -------	92.99 rpp.x mm*	105.00 rpp.x mm	12.01 rpp.x mm**
Height of photogram is again increased 100.00 units			
Height characteristic ----	**511.07 rpp.x mm**	**511.07 rpp.x mm**	**---- nil----**
Length characteristic -------	118.55 rpp.x mm*	133.73 rpp.x mm	15.18 rpp.xmm**

* Length characteristic of control and exhibit image is same.
** Length characteristic of control and altered image is different.
Table 10: The result and data are as under

(1) Increasing ratio of height and length characteristic of control and exhibit images, after fusion point is 1.00::1.00 Numerical figure of ratio value = 1.00 /1.00 = 0.00
(2) Increasing ratio of length characteristic of control and altered-exhibit images after fusion point is not 1.00::1.00. Numerical figure of ratio value is not 0.00

Conclusion is the subjects having different physical structure can be differentiated by equation comparison and increasing height after fusion point technique.

Comparison of two different side of the subject

Considering control image is with the record of investigating authority and exhibit image of the same person is obtained from the field having no record of front side direction plane and angle of photography. The images can also be compared for identity purpose by equation and fusion point technique of photogram.

For the purpose of experiment front side (FF) image is used as control and RR side image is used as exhibit. Available data are as under.

(1) Hs (con) =1550.0 rpp.x mm
(2) hp (con) = 66.102 rpp.x mm
(3) lp (con)=16.317 rpp.x mm
(4) hp (exh) = 35.764 rpp.x mm
(5) lp(exh) = 8.547 rpp.xmm
(6) Sequence of height is(1550.000, 66.102, 35.764)
(7) Sequence of length is(66.102, 16.317, 8.547)
(8) Upper fusion point of height is (23.21, 78.66)

Mathematical comparison:
Height sequence is (1550.000, 66.102, 35.764)
Height comparison equation is hp(con) X PR(con) X f = hp(exh) X PR(exh) X F
66.102 X 0.5410426 X 43.3396711= 35.764 X 1.8482831 X 23.4486097
1549.9999081 = 1549.99992
Length sequence is (66.102, 16.317, 8.547)
Length comparison equations is lp (con) X PR (con) X f = lp (exh) X PR(exh) X F
16.317 X 0.5238095 X 7.7339417 = 8.547 X 1.9090909 X 4.0531123.
66.1019967 = 66.101990.
Length of image x 23.4486097 = Height of subject.
66.1019967x 23.4486097 = 66.101990 X 23.4486097
1549.999921 = 1549.9999749

Comparison of increasing ratio after upper fusion point is as under

Control and exhibit photogram is practically enlarged up to fusion point of height and are again increased 50.0 units subsequently three times. Each stage is named as point 1, 2, 3 and 4 respectively.
(1)Sequence of height is (1550.000, 66.102, 35.764)
(2)Sequence of length is (66.102, 16.317, 8.547)
Point wise data are as under.

Point no.1
It is a fusion point of height sequence.
Image height of control (FF side) and exhibit (RR side) is 78.66 rpp mm.
Length of control (FF side) and exhibit (RR side) is measured, 19.45 rpp mm & 18.79 rpp mm.
Ratio of height: control:: exhibit -------- 78.66::78.66 = 1.00::1.00. ---------- (1)
Length of control and exhibit is 19.45 rpp.x mm and 18.79 rpp.x mm .
Ratio of length: control ::Exhibit -------- 19.45::18.79 = 1.035125::1.00000 ---------- (2)

Point no.2
Height of control and exhibit image is 128.79 rpp.x mm and 128.74 rpp.x mm.
Ratio of height: Control :: Exhibit------ 128.79 :: 128.74 = 1.00038 :: 1.00000---------(3)
Length of control and exhibit image is 31.78 rpp.x mm and 30.61 rpp.x mm.
Ratio of length: Control :: Exhibit ----- 31.78 :: 30.61 = 1.03822::1.00000 ---------- (4)

Point no.3
Height of control and exhibit image is 178.71rpp.x mm and 178.46 rpp.x mm.
Ratio of height: control :: exhibit ----- 178.71 :: 178.46 = 1.00140 :: 1.00000 ---------(5)
Length of control and exhibit is 44.05 rpp mm & 42.61 rpp.x mm
Ratio of length: Control ::Exhibit----- 44.05 :: 42.61 = 1.03379 :: 1.00000 ----------(6)

Point no.4
Height of control and exhibit is 228.77rpp.x mm and 228.41 rpp.x mm
Ratio of height: control :: exhibit----- 228.77 :: 228.41 = 1.00157 ::1.00000 ---------- (7)
Length of control and exhibit is 56.38 rpp mm & 54.51 rpp.x mm
Ratio of length: control::exhibit ----- 56.38 :: 54.51 = 1.034305:: 1.00000 ---------- (8)

Result:
(1) Height of control and exhibit subject is1549.9999 mm.
(2) Point wise increasing length ratio is 1.03 :: 1.00.
(3) Height and length characteristic of RR side image of exhibit subject is comparable with the FF side of the subject.
(4) Other available and appropriate body point characteristic from head, middle and leg regions are to be compare to confirm the identity.
(5) Angle of photography and angle of situation do not influence the result.
(6) Exhibit image of the subject that does not have data of front facial appearance can also be identified by increasing rate technique of photogram.

Front, back, right or left side of selected fifty subjects are snapped twice from different distance with the same angle of photography and same angle of situation. The subjects are having age between twenty to seventy years and having different height range, between 1490.0 mm to 1700.0 mm. One of the photographs is designated as control and other one is as exhibit. Time gaps between two snap is few seconds and two to three body points that selected from each region of the standing posture of the subject for comparison. Recent front side photograph of five subjects is used as control and front side photograph of same person is selected from album having time gape of about a year, used as exhibit image, with consideration that the angle of photography and angle of situation is 0° degree

Result & Conclusion

(1) Each side of exhibit image is comparable with respective side of the control image.
(2) Image comparison by photogram techniques is only a mathematical process of addition and multiplication of numeric figure.
(3)The result is obtained in the fractions of millimeter.
(4) Factors that affect the result are angle of photography, Angle of front side direction plane of subject, Region wise unpredicted turning, twisting, bending of the body limb from normal and natural posture
(5) Front side standing photograph of the subject is to be considered as normal and natural posture of the body.
(6) Ideal height of camera from the ground level is 2.5 to 3.0 feet, and direction plane of camera lens should be parallel with the ground level plane.
(7) Region wise 2-3 body point is to be selected for comparison.
(8) All these factors can be rectified by using camera along with magnetic compass.

Photogram technique of image comparison is useful to any investigating agency and to forensic science. As per evidence act it is a verifiable proof of identity. Aim of the study is to identify a criminal using his bodily structure even if front facial appearance is not available, person may have more than one name, pass ports, identity cards, and changes the outlooks by make-up can be identified. Wanted person can be search from targeted area. The exhibit image can be obtained without knowledge of that particular person, who is doubted by authority. Image comparison is nothing but only a mathematical process of addition and multiplication of the numeric figure. Forensic cases of altering and manipulating the image and black mailing the individual by showing a specific posture, minute difference between original and duplicate sculpture or paining, forged signature & hand writing can be solved by the these technique. Unauthorized entry of the doubtful credibility can be restricted and correctly inquired at security point. The sentence "You are under camera" will becomes more specific and correct.

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