Study of Matching Rate in Stim Test between Video-Polygraph Based on Vibraimage Technology and Traditional Contacting Polygraph

Choi Hyong Youn [1] (yelly301@naver.com),
Lee Jai Suk [1] (js09535@police.go.kr),
Kwan Choi [2] (kwan.choi@mindeye.co.kr)
[1] Scientific Investigation team at Seoul Metropolitan Police Agency
[2] COO in MINDEYE Corp, Seoul, Korea

Abstract: *Stimulation Test (STIM) as a preliminary step before the main lie detecting test (called as polygraph test) has being performed on a traditional contacting lie detector (polygraph). The purpose of this STIM test is to ensure the reliability of the test by showing the accuracy of the testing result to the subject, and to check the basic principle of sensor attachment or the subject's physiological response. According to the Korean Supreme Court's precedent (No. 83 Do 712) regarding polygraph tests, as he made a precondition for capacity of evidence that there must be a certain change in psychological state if subject lies, and whether subject is lying or not will be judged accurately by the physiological response and so on. Stimulation test (STIM) that can guarantee reliability of lie detection using Video-polygraph based on Vibraimage technology should be preceded as well. With 50 STIM test video data used in traditional contacting polygraph tests, we developed a program for Stimulation (STIM) test using Video-polygraph application based on Vibraimage technology.*

Keywords: *STIM, Polygraph, Psychology state, Physiology response, Vibraimage, Video-polygraph.*

John Larson was the first contacting polygraph examiner developed the equipment that could simultaneously measure three variables as breathing, blood pressure and pulse by heart activity. He has achieved results by applying contact polygraphs to numerous criminal cases and has made great contributions to expanding polygraph tests. Later, Leonard Keeler, Larson's disciple, developed a device to measure skin current resistance to Larson's machine in 1949 and then, introduced a card test and a special tension peak test. Since then, the polygraph test has been used as part of the procedure, which is called Stimulation (STIM) test by modifying the card test and the tension peak test to suit each situation. In STIM test as a way using a card (by John E. Reid, Fred E. Inbau), the investigator let the subject choose one card among 7 cards written from the number 1 to 7. After attaching the sensors onto subject's body, the investigator asks, "Is the card you picked number O?" which is written on the individual card from the number 1 to 7. Then, let subject answer "No" unconditionally. The purpose of this test is to demonstrate the efficacy and accuracy of polygraph technology, thereby arousing anxiety about lying to the subjects and identifying the acts that the subjects try to distort (Inbau&Reid, 1987).

In a similar manner to this card inspection method, Seoul Metropolitan Police Agency is conducting STIM tests by having the examinee write a number on the paper

https://doi.org/10.25696/ELSYS.10.VC3.EN
© The Authors, VIBRA2020. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (http://creativecommons.org/licenses/by/4.0/).

and analyzing at the responses of the examinee according to the number. In Seoul Metropolitan Police Agency's STIM test by writing the picked number on card, basically 3 time STIM tests are conducted just before the main polygraph test. The investigator ask to select one out of the number 3, 4, 5 from the number 1 to 7 and then, write them on paper. The investigator shall not select the number 1 and 2 for the padding purpose to eliminate interference from the adaptation stage and also, not select the number 6 and 7 in order to obtain a physiological response while the tension state is relieved after the stimulus is removed. Once the number is selected, the investigator attaches sensors (respiratory, cardiac activity, peripheral blood vessels) and runs the test.

The research of Video-polygraph application based on Vibraimage technology (Minkin, 2020) has been researched since 2011 after Vibraimage technology was firstly introduced in 2010 (Minkin &Nikolaenko, 2008; Vibraimage7PRO, 2010). This research by Lee Jai Suk, a senior investigator and others at the Seoul Metropolitan Police Agency, and VIBRASYSTEM team in Korea, very old partner with ELSYS (Minkin, 2017), have developed the 100% compatible lie detection procedure with the traditional contacting polygraph like BEKSTAR and UTAH methods. Its newly developed program is for testing authenticity by judging truth (NDI) or false (DI) or inconclusive (INC) generally called as "Comparison test" in Korea.

In 2011, the research team, including Lee Jai Suk (Scientific Investigator at Seoul Metropolitan Police Agency), used video files to capture the traditional polygraph test process and, produced 82.9% matching rate of the results of 120 criminal cases firstly, and after weighing some specific rates for the true or false judgment on the unique algorithm developed by VIBRASYSTEM team, the results at the researching time were consistent with 90.6% of the traditional contacting polygraph results (Suk&Hyun, 2011). In addition, in 2014, a new researching team including Korea university psychology specialists developed the real time analysis application while interviewing or stating that could examine false indications within 7 to 10 minutes by adopting a part of Enhancing Cognitive Interview. By structuring the new procedure for questioning and answering, '5 step questionnaire method' should be mandatorily kept and followed for satisfying this new "Interview test" (Jeong et al., 2014; Choi et al., 2018). Its accuracy rate was recorded about 89% on the basis that 5 step questionnaire procedure should be kept all the way. In 2019, 30 case video files captured and recorded for STIM test procedure were applied to the 'Comparison analysis' program based on Video-polygraph to check the developing possibility of STIM test. 29 cases showed the very meaningful response in the number stimulation. There was also a significant response in CIT (Concealed Information Test). So, at the end, we studied STIM test by using the new 50 cases after checking the possibility of applying Vibraimage technology.

Material and Method

Video-polygraph system based on Vibraimage technology is also operated by computer like the standard Vibraimage applications. Its system is composed of computer installed Video-polygraph analysis programs, monitor, camera with the fixed resolution (640×480). The specification of standard PC with processor Intel Core Ivy Bridge i5 or higher was

used with the specific dongle for Vibraimage software protection. Web-camera was fixed at the distance of approximately 1~1.5 m in front of the head of the subject so that the facial image can be maximized during the whole lie detection process. Also, low-frequency video camera (frame rate, 25–30 Hz) was used in order to increase accuracy of micromovement monitoring. The testing room under the stable luminance was so much consistent for better video quality because all investigating rooms in police agency was isolated for the minimum noises. All of 50 video files were captured by AVI codec format as Vibraimage applications required usually.

For increasing the matching rate with the result of STIM test by the traditional contacting polygraph, we newly structured and formed the required standard questionnaire method, which added ST (State Tracking) stage at the beginning stage of STIM test. The period of ST stage was about 40–60 seconds, preferable longer than 40 seconds. During ST stage, the psychophysiological state to subjects could get stable and relaxed by taking a rest quietly with eye-closed state or eye-opened state. After ST stage, all 7 questionnaires would be sequentially asked as the usual STIM test procedure. We asked 7 time questionnaires with the number 1, 2, 3, 4, 5, 6, 7 as called Q1, Q2, Q3, Q4, Q5, Q6, Q7. The interval duration between questions, for example, interval of Q3 and Q4, would be also kept about 15–20 seconds as usual.

Fig. 1. Question Structure for STIM test

And for extracting the calculation algorithm to pick up the highest responding question, we assumed four (4) major parameters, K parameter related to Psychophysiological information change, L parameter related to Energy metabolism change, M parameter related to Sensitivity and N parameter related to Exciting state. We would make a final assessment and judgement by combining those 4 parameters. Each parameter has 2-point scores and finally 8 point scores out of 4 parameters totally. Every question from Q1 to Q7 would have the calculated scores from 0 at minimum to 8 points at maximum. Finally, the investigator would select the corresponding question number (Q3 or Q4 or Q5) with the highest score. The variable relation between I and E (Minkin&Nikolaenko, 2017) was shown on figure 2. And the variable relation between F3 and P2 was shown on figure 3. The personalized reference level in ST stage was indicated by dash-line on both figures. The personalized reference line would be for comparing the actually stimulating responses to each period. All subjects had a different reference level because the reference level was dependent upon the psychophysiological state while testing at the stable state (ST stage).

By table 1 shown on below, Q5 stage indicated the highest scores as 4 points, other 2 stages at Q3 and Q4, had 2 points respectively. Finally, we could judge that the highest response was occurred at Q5 stage. So, we could select Q5 as the period of the highest response in STIM test.

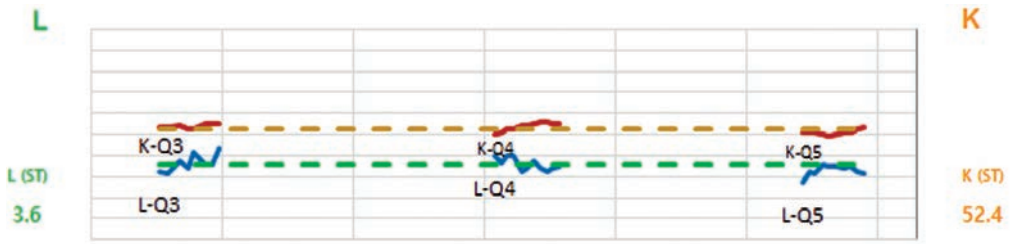

Fig. 2. Relation between I and E

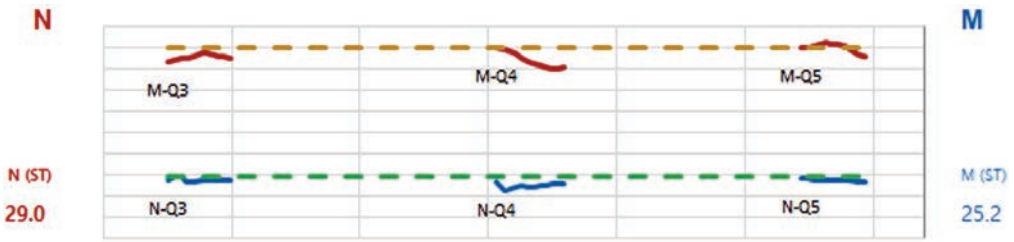

Fig. 3. Relation between F3 and P2

Table 1

Detailed calcuration table for 4 major parameters highky influenced to STIM response

Responses Q2 ~ Q6									
Stage		Q2	Q3	Q4	Q5	Q6	Analysis		
K	Min	50.28	52.88	50.29	49.58	48.32			Q5
	Max	52.53	55.09	55.94	53.13	54.08			
	Start	52.26	53.72	50.29	50.68	54.08			
	End	52.06	54.80	54.89	53.13	48.32		Q4	
	Delta	0.20	-1.08	-4.60	-2.46	5.76			
L	Min	3.96	3.14	3.25	2.75	3.37	Q3		
	Max	4.78	4.35	3.96	3.57	4.67			
	Start	3.96	3.25	3.96	2.75	3.37			
	End	4.55	4.35	3.45	3.14	3.57		Q4	
	Delta	-0.59	-1.10	0.51	-0.39	-0.20			
M	Min	24.67	23.26	22.39	24.08	25.43			Q5
	Max	26.23	24.48	25.07	25.77	27.78			
	Start	25.66	23.26	25.07	25.25	25.43			
	End	24.67	23.85	22.62	24.08	27.78			Q5
	Delta	0.99	-0.59	2.45	1.17	-2.35			
N	Min	23.98	26.78	22.57	26.80	25.46	Q3		
	Max	30.32	29.08	26.94	28.20	27.64			
	Start	26.94	27.42	26.94	28.20	25.46			
	End	25.00	27.64	25.87	26.80	27.64			Q5
	Delta	1.94	-0.23	1.07	1.40	-2.18			
							2	2	4
Final Judgment							Q5		

As a result of comparison test between the contacting polygraph and Video-polygraph based on Vibraimage technology, we could get that the matching rate was 96% in accuracy. There are two (2) cases to be mismatched between the contacting polygraph method and the non-contacting Video-polygraph method.

Table 2

Total Cases	Matched Cases	Mis-matched Cases	Matching rate with the result of STIM by contacting polygraph
50	48	2	96%

Conclusion

We conducted STIM test by 50 cases to all subjects tested for the official lie detection. The result of STIM test between the contacting polygraph and Video-polygraph was analyzed and the matching rate was 96%. But two (2) cases could be finally matched when we modified and amended the calculation equation and assessment algorithm for STIM test based on Video-Polygraph. By this remarkable and promising assessment result for STIM test, we will extend to apply to CIT process. The testing procedure of CIT is similar to STIM test but CIT requires to indicate and make the responses in regular order from the highest response to the lowest response. In the near future, we will test 100 cases furthermore in STIM test under the real situation. Also, we will perform the CIT work. Both testing programs will contribute to increase the accuracy, to improve the efficiency and to strengthen the work performance in scientific investigation. At the end, Video-polygraph will leverage the most of the scientific investigation by various of the examining applications like 'Comparison test', 'Interview test', STIM and CIT as well as the psycho-physiological state test. This research will get so important because STIM test is very fundamental in psycho-physiological response test and contribute to the significant improvement in scientific investigation industry. The high matching rate in the STIM test (picking the number written by the test subject) is so meaningful in terms of the accuracy of Video-polygraph. As it is consistent with not only purpose and precedent of the case but also human rights-friendly in a contactless manner, it will be an opportunity to use the lie detection equipment, which is interchangeable with the currently contacting polygraph equipment.

References:

1. Choi Jin Kwan, Lee Jai Suk and Kim Hyun Taek (2018). Research of Video Polygraph for lie detection with statement analysis by Vibraimage technology, Proceedings of the 1st International Open Science Conference, Modern Psychology. The Vibraimage Technology, Saint Petersburg, Russia, 28–29 June 2018, pp. 150–158. DOI: 10.25696/ELSYS.VC1.EN.5

2. Jeong Seok Hwan, Choi Jin Kwan and Lee Jai Suk (2014). Possibility of video-polygraph based on lie detection with statement analysis by Vibraimage technology. Korea Police Polygraph Association.
3. Inbau, F. E. and Reid, J. E. (1987). Truth and False. Lee Yong Sik translation, pp. 13–21.
4. Minkin, V. A. and Nikolaenko, N. N. (2008). Application of Vibraimage Technology and System for Analysis of Motor Activity and Study of Functional State of the Human Body, Biomedical Engineering, Vol. 42, No. 4, pp. 196–200. DOI: 10.1007/s10527-008-9045-9
5. Minkin, V. A. (2017). Vibraimage. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VI.2017
8. Minkin, V. A. and Nikolaenko, Y. N. (2017). Vibraimage and Multiple Intelligences. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VIMI.2017
9. Minkin, V. A. (2020). Vibraimage, Cybernetics and Emotions. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VCE.2020
10. Suk, L. J. and Hyun, J. S. (2011). Research to verify and utilize psychophysiological detection of deception based on 3D image processing technology. Korea Association of Criminal Psychology, 7(3), pp. 209–230.
11. Vibraimage7PRO (2010). Vibraimage system for human psychophysiological behavioral control. [Electronic resource]. Available at: https://psymaker.com/downloads/VI7_5ManualEng.pdf (Access: 22 March 2020).