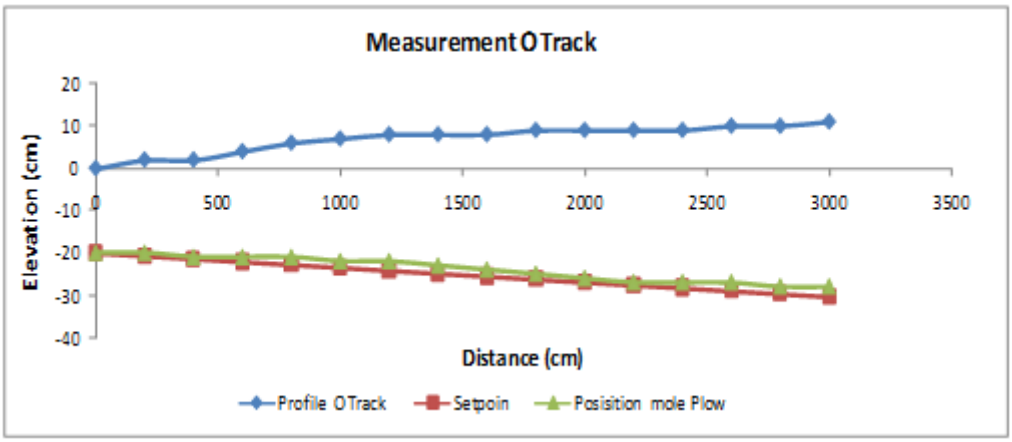

Figure 4.3: Graph of ploughing elevation toward setpoint at O track

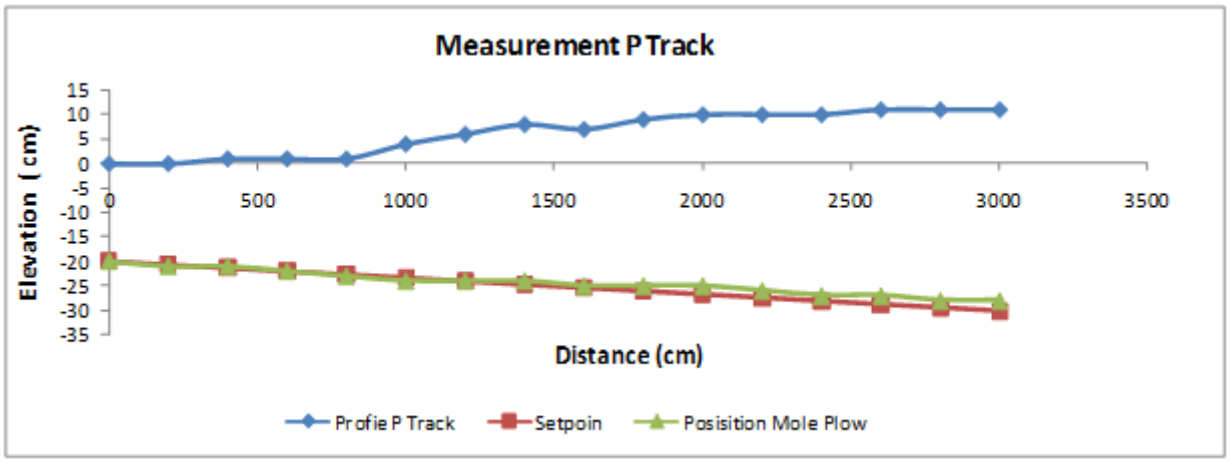

Figure 4.4: Graph of ploughing elevation toward setpoint at P track

Referring to Fig. 4.1 up to 4.4, it can be seen that the soil surface profile still influenced the ploughing depth. Therefore, a deviation between set point and the actual position still occurred. When the elevation of soil surface increased, the position of mole plough was maintained close to the specified set point.

4.2 Discussion

Referring to Fig. 4.1 up to 4.4, the result of soil surface profile significantly influenced the result of ploughing depth elevation. Therefore, a deviation between set point and ploughing depth still occurred. The deviation was analyzed using Eq. 4.1.

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - x_n)^2}{n}} \qquad (4.1)$$

Whereas:
n : number of data
x_i : data average
x_n : n-data

Based on the measurement and analysis, the deviation magnitude is shown in Table 4.3

Table 4.3: Deviation between set point and ploughing elevation

Track	Deviation (%)	Slope
M	1,05	Controlled at 0.2 % slope
N	1,08	
O	0,78	
P	0,96	

5. Conclusion

Referring to the research result using control system at 0,02% slope showed that the profile of soil surface still influenced the ploughing depth position. When the elevation of soil surface increased, the position of mole plough was maintained close to the specified set point. Ultrasonic distance sensor was appropriate to detect the ploughing depth. The deviation occurred at M, N, O and P tracks with magnitude of 0,99; 1,04; 0,63 and 0,87, respectively.

Reference

[1] Atmel. 2010. *Manual book ATmega 238*. Mikrokontroller, Revisi 05861 AVR 07/10. Atmel Asia. Kwun Tong. Hongkong.
[2] Boylestadt, Robert dan Louis Nashelsky. 2007. *Electronic Device and Circuit Theory* . Fourth Edition. USA: Prentice H all, Inc

[3] Kadir A. 2012. *Panduan Praktis Mempelajari Aplikasi Mikrokontroller dan Pemogramannya Menggunakan Arduino*. Andi. Yogyakarta.
[4] M. Hariansyah, Setiawan RPA, Desrial, Made DS. 2013. *Design And Response Characteristics Of Electronic Kontrol Sistem On Hydraulic-Driven Mole Plough,* IJSR (International Journal of Science and Research, ISSN (Online): 2319-7064,Volume 2 Issue 11.
[5] Prawiroredjo K & Asteria N. 2008. *Detektor Jarak Dengan Sensor Ultrasonik Berbasis Mikrokontroler*. JETri. Volume 7. Nomor 2. 2008. ISSN 1412-0372 . Jurusan Teknik Elektro. FTI Universitas Trisakti.P41-52
[6] Saeys W, A. M. Mouazen, J. Anthonis, H. Ramon. 2004. *An Automatic Depth Kontrol Sistem For On-Line Measurement Of Spatial Variation In Soil Compaction.* Department of Agro-Engineering and Economics, Faculty of Agricultural and Applied Biological Sciences. Kasteelpark Arenberg 30 B-3001 Heverlee. Belgium.

Author Profile

M. Hariansyah received the Ir. degrees in Electrical Engineering from University of Pakuan Bogor in 1996. M.T degress in Electrical Engineering from Institut Saint and Technology Jakarta, in 2007. He is studing Department of Mechanical and Biosistem Engineering, Faculty of Agricultural Engineering and Technology, Bogor Agricultural University, Indonesia.

Radite P.A Setiawan is lecturer at Department of Mechanical and Biosystem Engineering, Bogor Agricultural University (IPB), Indonesia since 1986. He received M.Agr. degree from Kyoto University, Japan and Ph.D from Kyoto University, Japan. His research interests include instrumentation and control, engineering design (especially in equipment) and agricultural machinery, mechatronics, mechanical engineering and agricultural cultivation and automatic control

Asep Sapei is working as lecturer at Department of Agricultural Engineering FATETA-IPB from 1980until the end of 2008, since the end of2008 and he is as lecturer Department of Civil and Environmental Engineering FATETAIPB. In 1986 He received the MS degree from the Faculty of Agricultural Mechanization from Mechanization and Agricultural Technology, Bogor Agricultural University. In 1996 he received Ph. D from University of Tokyo, and in 2004was appointed professor of Soil and Water Engineering field. He has made numerous scientific publications both nationally and internationally, the 15 paper sin scientific journals,11papers in international seminars and 13 papers at national seminars.

Desrial is working as lecturer at Department of Mechanical and Biosystem Engineering, Bogor Agricultural University (IPB), Indonesia since 1990. He received M.Eng. degree from AIT Bangkok Thailand and Ph.D from MIE university, Japan. His research interests include instrumentation and control Agric Machinery design. He has published 21 references consist of Journal, and both national and international proceeding

Dewa Made Subrata is working as lecturer at Department of Mechanical and Biosystem Engineering, Bogor Agricultural University (IPB), Indonesia since 1988. He received M.Agr. degree from Shimane University, Japan and Ph.D from Tottory University, Japan. His research interests include instrumentation and control, robotic, and mechatron ics. He has published 18 references consist of Journal, and both national and international proceeding.