

## APPENDIX 4

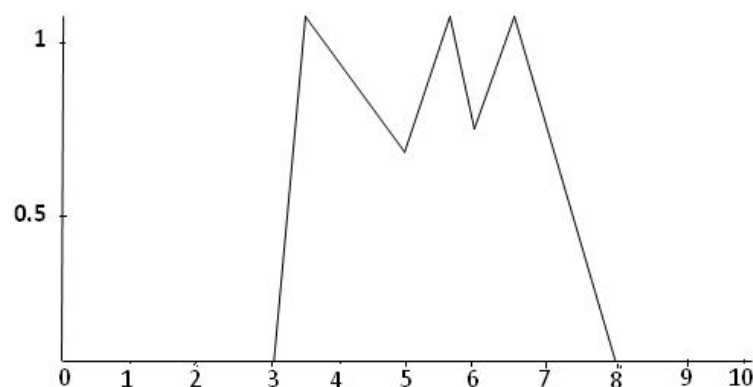
### PROBABILITY OF A NODE BEING CLUSTER HEAD

#### CENTER OF GRAVITY

The probability of node being elected as Cluster Head (CH) is obtained by using the following equation,

$$COG(CH) = \frac{\int \mu_{CH}(X)XdX}{\int \mu_{CH}(X)dX} \quad (A4.1)$$

The following section explains the probability of node being elected as CH when its membership functions are Residual Energy is 'RH' (4-7), Least Recently selected (LRS) is 'H' (5-8) and Number of Neighbours (NN) is 'M' (3-6). (Rule 54 from Table 2.2)



**Figure A4.1 Center of gravity method of Defuzzification**

Probability of node being elected as CH

$$COG(CH) = \frac{\int_3^{4.5} 1XdX + \int_{4.5}^5 0.65XdX + \int_5^{5.5} 1XdX + \int_{5.5}^6 0.75XdX + \int_6^{6.5} 1XdX + \int_{6.5}^8 1XdX}{\int_3^{4.5} 1dX + \int_{4.5}^5 0.65dX + \int_5^{5.5} 1dX + \int_{5.5}^6 0.75dX + \int_6^{6.5} 1dX + \int_{6.5}^8 1dX} \quad (A4.2)$$

$$\begin{aligned} &= \frac{\left[ \frac{X^2}{2} \right]_3^{4.5} + \left[ \frac{0.65X^2}{2} \right]_{4.5}^5 + \left[ \frac{X^2}{2} \right]_5^{5.5} + \left[ \frac{0.75X^2}{2} \right]_{5.5}^6 + \left[ \frac{X^2}{2} \right]_6^{6.5} + \left[ \frac{X^2}{2} \right]_{6.5}^8}{[X]_3^{4.5} + [0.65X]_{4.5}^5 + [X]_5^{5.5} + [0.75X]_{5.5}^6 + [X]_6^{6.5} + [X]_{6.5}^8} \\ &= \frac{5.625 + 1.5375 + 2.625 + 2.1562 + 3.125 + 10.875}{1.5 + 0.325 + 0.5 + 0.375 + 0.5 + 1.5} \\ &= \frac{25.94995}{4.7} = 5.5 \end{aligned} \quad (A4.3)$$

$COG(CH) = 5.5$  (Probability of node being elected as CH)

| RE  | LRS | NN  | P   |
|-----|-----|-----|-----|
| RH  | H   | M   | RH  |
| 4-7 | 5-8 | 3-6 | 4-7 |

**Rule No. 54 in Table 2.2 is verified.**

The probability obtained is the chance of node being elected as CH and it depends on Residual energy, Least Recently Selected and Number of Neighbours. The performance of the network is analyzed in Chapter 2.