# List of Figures

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Name of Figure</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Wireless Networks: Taxonomy</td>
<td>10</td>
</tr>
<tr>
<td>2.2</td>
<td>TRUETIME library block</td>
<td>17</td>
</tr>
<tr>
<td>2.3</td>
<td>Simplified User's View of NS</td>
<td>18</td>
</tr>
<tr>
<td>2.4</td>
<td>Architectural View of NS</td>
<td>19</td>
</tr>
<tr>
<td>2.5</td>
<td>TRACE files Format</td>
<td>22</td>
</tr>
<tr>
<td>2.6(a)</td>
<td>Topology of the network in NAM</td>
<td>25</td>
</tr>
<tr>
<td>2.6(b)</td>
<td>Packet drops in queue of network (in NAM)</td>
<td>29</td>
</tr>
<tr>
<td>2.7</td>
<td>5 wireless node topology in NS2</td>
<td>29</td>
</tr>
<tr>
<td>2.8</td>
<td>Nam Output Of The Wirelestelest2.Tcl File</td>
<td>35</td>
</tr>
<tr>
<td>3.1</td>
<td>Ad hoc Routing Protocols – Classification</td>
<td>42</td>
</tr>
<tr>
<td>3.2</td>
<td>Scenario Created For Wireless Ad-Hoc Network in Qualnet</td>
<td>52</td>
</tr>
<tr>
<td>3.3</td>
<td>Information packet exchange between the nodes of the network in Qualnet</td>
<td>53</td>
</tr>
<tr>
<td>3.4</td>
<td>Average Packet Delivery Ratio V/S Maximum Speed and node density</td>
<td>54</td>
</tr>
<tr>
<td>3.5</td>
<td>Average end to end Delay V/S Maximum Speed and node density</td>
<td>55</td>
</tr>
<tr>
<td>3.6</td>
<td>Average Throughput V/S Maximum Speed and node density</td>
<td>55</td>
</tr>
<tr>
<td>3.7</td>
<td>Average Jitter V/S Maximum Speed and node density</td>
<td>56</td>
</tr>
<tr>
<td>3.8</td>
<td>Average Packet Delivery Ratio V/S Maximum Speed and node density</td>
<td>57</td>
</tr>
<tr>
<td>3.9</td>
<td>Average end to end Delay V/S Maximum Speed and node density</td>
<td>58</td>
</tr>
<tr>
<td>3.10</td>
<td>Average Throughput V/S Maximum Speed and node density</td>
<td>58</td>
</tr>
<tr>
<td>3.11</td>
<td>Average Jitter V/S Maximum Speed and node density</td>
<td>59</td>
</tr>
<tr>
<td>3.12</td>
<td>Average Packet Delivery Ratio V/S Mobility</td>
<td>60</td>
</tr>
</tbody>
</table>
3.13 Average Packet Delivery Ratio V/S Node Density 60
3.14 Average end to end Delay V/S Mobility 61
3.15 Average end to end Delay V/S node density 61
3.16 Average Throughput V/S Mobility 61
3.17 Average Throughput V/S node density 61
3.18 Average Jitter V/S Mobility 62
3.19 Average Jitter V/S node density 62
3.20 Average Packet Delivery Ratio V/S Mobility 63
3.21 Average Packet Delivery Ratio V/S node density 63
3.22 Average end to end Delay V/S Mobility 63
3.23 Average end to end Delay V/S node density 63
3.24 Average Throughput V/S Mobility 64
3.25 Average Throughput V/S node density 64
3.27 Average Jitter V/S Mobility 65
3.28 Average Jitter V/S node density 65
4.1 The Architecture of Fuzzy Inference System 72
4.2 Simple model of an Artificial Neuron 75
4.3 Multi-layer Network 77
4.4 ANFIS Architecture 91
4.5(a) A Schematic Diagram Of Main Features: MATLAB 93
4.5(b) MATLAB command window 94
4.6 SIMULINK library browser window 95
4.7 ANFIS Editor GUI 97
5.1 Simulink model in Truetime 108
5.2 Topology created by Simulink model in Truetime 109
5.3 Results on Command window for AODV Simulink model
5.4 Signal Reach v/s Tx Power
5.5 Packet delivery Ratio v/s Transmission Power
5.6 End to End delay (sec) v/s Power (dBm)
5.7 Rule Viewer
5.8 Surface Viewer
5.9(a) Block schematic of ANFIS
5.9(b) ANFIS model structure
5.10 Error v/s Epochs
5.11 Surface viewer for ANFIS
5.12 Comparisons between Simple AODV, Fuzzy AODV and ANFIS AODV
5.13 Parts of GUI implementation
5.14 User Interface for Application
5.15 GUI for password
5.16 GUI showing initialization
5.17 GUI showing node topology
5.18 Fuzzy AODV and ANFIS AODV
5.19 Various response for view menu
5.20 Response of PDR and results of workspace
6.1 the Route Request packets flooding in AODV
6.2 Forwarding of Route Reply packet in AODV
6.3 Fuzzy control Architecture
6.4 Fuzzy Inference System with respective inputs and outputs.
6.5 Membership Functions Selection for Fuzzy Inference System (Fuzzy AODV)
6.5(a) MBF Library
6.5(b) MBF Editor: FIS for Hello Interval (HI) 133
6.6 Surface Viewer for FIS Hello Interval (HI) 134
6.7(a) Scenario Created For Wireless Ad-Hoc Network in Qualnet 135
6.7(b) Scenario Created For Wireless Ad-Hoc Network in Qualnet 136
6.8(a) Average Packet Delivery Ratio V/S Pause time for nodes 30 138
6.8(b) Average Packet Delivery Ratio V/S Pause time for nodes 40 138
6.9(a) Average Throughput V/S Pause Time for node 30 139
6.9(b) Average Throughput V/S Pause Time for node 40 139
6.10(a) Average Jitter V/S Pause Time for node 30 139
6.10(a) Average Jitter V/S Pause Time for node 40 139
6.11(a) Average Received Packets V/S Pause Time for nodes 30 140
6.11(b) Average Received Packets V/S Pause Time for nodes 40 140
7.1 A learning Cycle in the ANN model 143
7.2(a) ANN with respective inputs and outputs 146
7.2(b) ANN layered Architecture with neurons 146
7.3 Process of Optimization of MANET 147
7.4 Training of Artificial Neural Network Hello Interval (HI) 148
7.5(a) Average Packet Delivery Ratio V/S Pause Time for nodes 30 149
7.5(b) Average Packet Delivery Ratio V/S Pause Time for nodes 40 149
7.6(a) Average Throughput V/S Pause Time for nodes 30 149
7.6(b) Average Throughput V/S Pause Time for nodes 40 149
7.7(a) Average End to End Delay V/S Pause Time for node 30 150
7.7 Average End to End Delay V/S Pause Time for node 40 150
7.8(a) Received Packets V/S Pause Time for node 30 150
7.8 (b) Received Packets V/S Pause Time for node 40 150
8.15 Average End to End Delay V/S Pause Time for nodes 30, 40
8.16 Average Received Packets V/S Pause Time for nodes 30, 40
8.17 Average comparison of performance metrics for nodes 30 and 40
9.1(a) Relative Difference Of Purelin Type ANN
9.1(b) Relative Difference Of Tansig Type ANN
9.2 Average Packet Delivery Ratio V/S Pause Time Of Nodes 40
9.3 Average End To End Delay V/S Pause Time Of Nodes 40
9.4 Average Throughput V/S Pause Time Of Nodes 40
9.5 Average Jitter V/S Pause Time Of Nodes 40
9.6 Average Number Of Received Packets V/S Pause Time Of Nodes 40
9.7 Average Packet Delivery Ratio V/S Pause Time Of Nodes 30
9.8 Average End To End Delay V/S Pause Time Of Nodes 30
9.9 Average Throughput V/S Pause Time Of Nodes 30
9.10 Average Jitter V/S Pause Time Of Nodes 30
9.11 Average Number Of Received Packets V/S Pause Time Of Nodes 30
A.1 ISE Design flow
A.2 Snap Shot Of Xilinx ISE Design Suite Icon
A.3 New Project Wizard: Create New Project Page
A.4 New Project Wizard: Project Settings
A.5 Project Summary
A.6 Status of Source Files and Associations
A.7 Process Pane
A.8 ISim Properties Dialog Box
A.9 ISim Graphical User Interface
A.10 Wave Window
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.11(a)</td>
<td>snap shot of boundary scan and adding Xilinx devices</td>
<td>228</td>
</tr>
<tr>
<td>A.11(b)</td>
<td>snap shot of boundary scan after adding Xilinx devices</td>
<td>229</td>
</tr>
<tr>
<td>A.12</td>
<td>PROGRAM Launch window</td>
<td>229</td>
</tr>
<tr>
<td>A.13(a)</td>
<td>Snap Shot of XCV5LX110T FPGA Board</td>
<td>231</td>
</tr>
<tr>
<td>A.13(b)</td>
<td>Snap Shot of XCV5LX110T FPGA Board with peripherals</td>
<td>231</td>
</tr>
<tr>
<td>C-I</td>
<td>WANET: Power Control by SOFTAODV User Interface</td>
<td>239</td>
</tr>
<tr>
<td>C-II</td>
<td>WANET: Power Control by SOFTAODV User Interface, Documentation</td>
<td>239</td>
</tr>
<tr>
<td>C-III</td>
<td>WANET: Power Control by SOFTAODV User Interface, SOFT_AODV Menu</td>
<td>240</td>
</tr>
<tr>
<td>C-IV</td>
<td>WANET: Power Control by SOFTAODV User Interface, Hardware implementation</td>
<td>240</td>
</tr>
<tr>
<td>C-V</td>
<td>WANET: Power Control by SOFTAODV User Interface, DEMO</td>
<td>241</td>
</tr>
<tr>
<td>C-VI</td>
<td>WANET: Power Control by SOFTAODV User Interface, Help</td>
<td>241</td>
</tr>
</tbody>
</table>