LOCALISATION OF WIRELESS SENSOR NETWORK
WITH MOBILE BEACON BY DYNAMIC PATH

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Submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

22 April 2013
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STATEMENT OF ORIGINALITY

I, Songsheng Li, declare that I am the author of this document and that I have not used fragments of text from other sources without proper acknowledgment, and that theories, results and designs of others that I have incorporated into my report have been appropriately referenced and all sources of assistance have been acknowledged.

Signature: 
Date: 22 April 2013
**ABSTRACT**

Small size and low-cost sensors are practicable because of evolution of the semiconductor field, which is led by increasing miniaturisation. They are still limited in processor capacity, memory size and energy resources; however, ubiquitous wireless is added to extend their communication capacity. Wireless sensor networks (WSN) are formed by large numbers of such sensors and can be used to monitor a field of interest in military and civilian areas.

The resulting data are only meaningful when combined with geographical position information of the sensors. Both the Global Positioning System (GPS) and the Global System for Mobile Communication (GSM) are hungry for energy and expensive, and are not suitable to be used extensively in every sensor. But localisation is essential in WSN, which should be implemented with help of some beacons that are equipped with GPS or GSM.

A mobile beacon (MB) is the replacement of many static beacons; it is movable and flexible and can be powerful so that some heavy computational mathematical methods (such as probability and graph theory) could be applied in an algorithm of localisation.

The walking path of a MB will determine the rate of coverage and accuracy of localisation. The static path is planned before action and is suitable for regular terrain; whereas, the dynamic path is decided in real-time action depending on the demand of unknown sensors, and is more efficient than the static path.

Concentrating on the algorithm of dynamic path to reach a better result in terms of accuracy, coverage, and trajectory of localisation in WSN, a framework of dynamic path of mobile beacon (DPMB) is proposed first, and then reinforcement learning (RL) is fit to the DPMB as the inner controller to improve the performance. Finally, direction is employed to assist the MB to find a better next position instead of distance in the DPMB. Simulations demonstrate that the performance is improved gradually.
ACKNOWLEDGEMENTS

I wish to express my gratitude to my supervisors Dr. Xiaoying Kong and Prof. David Lowe for their suggestions, logical way of thinking, encouragement and generous support. I would be lost without their guidance.

I would like to extend my appreciation to the administrative officers of the FEIT and UGS for their friendly support.

Finally, I wish to express my deepest gratitude to my family for helping me get through the difficult times. Without their encouragement, it would have been impossible for me to complete this research work.
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# List of Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADO</td>
<td>Arrival and Departure Overlap</td>
</tr>
<tr>
<td>AoA</td>
<td>Angle of Arrival</td>
</tr>
<tr>
<td>AoS</td>
<td>Area number of the Sensor</td>
</tr>
<tr>
<td>APIT</td>
<td>Approximate Point in Triangulation Test</td>
</tr>
<tr>
<td>APS</td>
<td>Ad Hoc Positioning System</td>
</tr>
<tr>
<td>BTG</td>
<td>Backtracking Greedy</td>
</tr>
<tr>
<td>BRF</td>
<td>Breadth-First</td>
</tr>
<tr>
<td>CoM</td>
<td>Count of Message</td>
</tr>
<tr>
<td>DPMB</td>
<td>Dynamic Path of Mobile Beacon</td>
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<tr>
<td>DV</td>
<td>Distance Vector</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communication</td>
</tr>
<tr>
<td>GSW</td>
<td>Group Similarity Weight</td>
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<tr>
<td>LMB</td>
<td>Localisation with a Mobile Beacon</td>
</tr>
<tr>
<td>MB</td>
<td>Mobile Beacon</td>
</tr>
<tr>
<td>MBAL</td>
<td>Mobile Beacon-Assisted Localisation</td>
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<tr>
<td>MBP</td>
<td>Mobile Beacon Position</td>
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<tr>
<td>MDS</td>
<td>Multidimensional Scaling</td>
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<tr>
<td>MLE</td>
<td>Maximum Likelihood Estimation</td>
</tr>
<tr>
<td>QoN</td>
<td>Quantity of Neighbours</td>
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<tr>
<td>PDF</td>
<td>Probability Distribution Function</td>
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<tr>
<td>RF</td>
<td>Radio Frequency</td>
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<tr>
<td>RL</td>
<td>Reinforcement Learning</td>
</tr>
<tr>
<td>RSS</td>
<td>Radio Signal Strength</td>
</tr>
<tr>
<td>RSSI</td>
<td>Received Signal Strength Indicator</td>
</tr>
<tr>
<td>SDP</td>
<td>Semidefinite Programming</td>
</tr>
<tr>
<td>SMC</td>
<td>Sequential Monte Carlo</td>
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<tr>
<td>ToA</td>
<td>Time of Arrival</td>
</tr>
<tr>
<td>TDoA</td>
<td>Time Different of Arrival</td>
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<tr>
<td>VCS</td>
<td>Vector Cosine Similarity</td>
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<tr>
<td>WSN</td>
<td>Wireless Sensor Networks</td>
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