Multipath Detection Using the Dendritic Cell Algorithm

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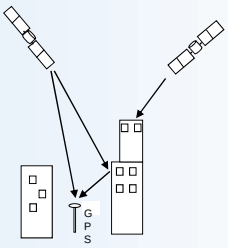
Introduction

- GNSS Signal multipath occurs when the GNSS signal arrives via multiple paths.
- This occurs when the GNSS signal is reflected off objects in the antenna environment. This is a significant problem when using GNSS in urban areas.
- Multipath is still an unresolved issue for high precision GNSS. With the increased use of code GNSS for Location Based Services, personal and indoor navigation, multipath is even more of a problem for such applications.



Dendritic Cell Algorithm (DCA)

- The DCA is a novel immune-inspired algorithm based on the function of the Dendritic Cells (DC) in the human body.
- In nature, DCs function as natural anomaly detection agents, instructing the immune system to respond if stress or damage is detected.
- **Signals**: The DCA requires two input signal to function. These are the '**Danger**' and '**Safe**' signals.
- *Danger Signal: that which is high when the content is bad and low when the context is good.*
- *Safe Signal: that which is high when the context is good and low when the context is bad.*
- The danger (D) and safe (S) signals are combined to form the k and csm such that: $csm = S + D$, and $k = D - 2S$
- **Antigens**: DCs perform signal fusion and correlation with antigens. Antigens are identifiers of the state or context (e.g. a set of epochs or process IDs)

D	S	K=D-2S
9	3	3
6	2	2
...	...	...

The DCA Process

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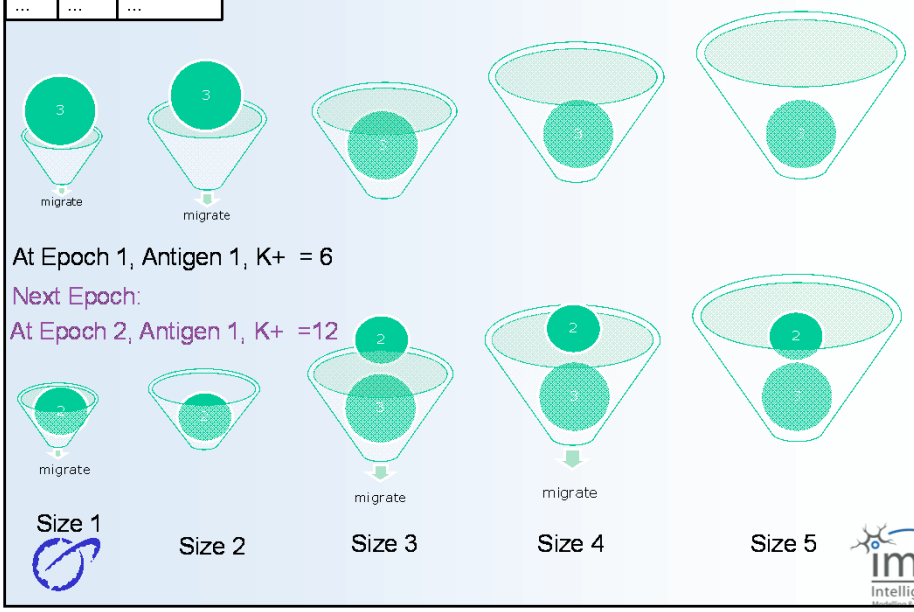
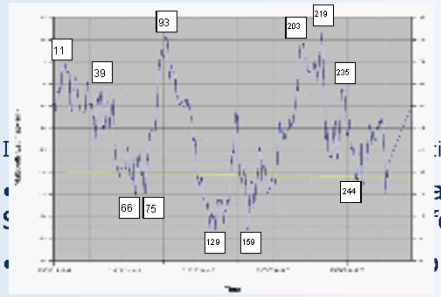
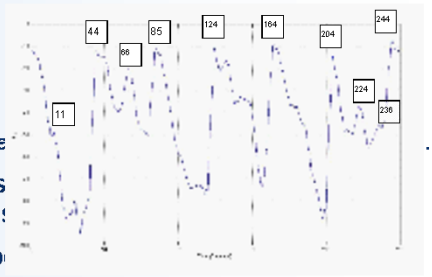


DCA Applied to GPS Data

- **What are my danger and safe signals in a GPS context?**
- The danger signal is that which is high when the context is bad and low when the context is good.
- In this application the bad context will be the presence of multipath. Antigens were created by grouping 5 epochs of data into overlapping sets
- The Range Residual (RR) is computed as:



Leica QC Multipath Estimates



DCA Kα Anomaly Output