AGLOCELL

Improve SINR by 8% to 15% to Increase Throughput and Capacity

Executive Summary

With the increase of wireless technologies in communication networks, one inherent challenge is interference. Regardless of the type of network, performance is always limited by the noise level in the system.

The level of interference determines the throughput and capacity. For example, uplink noise level optimization of a 5G/4G network can dramatically improve its performance. The patent pending, AI based AGLOCELL Uplink Interference algorithm improved SINR by 8% - 15% correspondently increasing throughput and network capacity

The driving force behind modern communication systems is to provide the highest capacity at a given bandwidth. To make this goal, networks are TDMA in nature, so many users can share the same channel. In addition to the bursty nature of signal characteristics, tight frequency reuse is widely deployed to increase overall network capacity. This introduces co-channel interference.

The case study was performed in a major US metro area providing the following findings:

- The AGLOCELL AI based Uplink Interference algorithm was utilized to detect uplink interference within the Radio Access Network (RAN).
- It was shown that RAN cells with uplink interference over a pre-determined threshold degraded the overall system performance.
- The AGLOCELL Uplink Interference algorithm optimize UL interference and SINR, by means of RF parameter and tilt changes.
- The AGLOCELL Uplink Interference algorithm improved SINR by 8% - 15% providing a corresponding increase in end user throughput.

Challenges

With the exponential growth in the demand for mobile data, wireless systems in general are experiencing densification of the wireless network elements that provide mobile data access. A notable example of wireless systems that have followed this densification trend is cellular systems, in which the high demand for data has been addressed through heterogeneous cellular networks (HCNs). HCNs or small cells have been a paradigm shift in the deployment of cellular network infrastructure, moving away from expensive high-power macro base stations mounted on towers to less expensive lower-power small cells mounted on buildings and light poles, due to scarcity of the spectrum, wireless systems have to reuse the available spectrum, which in turn leads to excessive interference. In the context of small cells, uplink interference is one of the major performance-limiting factors, which has fueled development of the patent pending AI based AGLOCELL Uplink Interference algorithm.

Algorithm Functionality

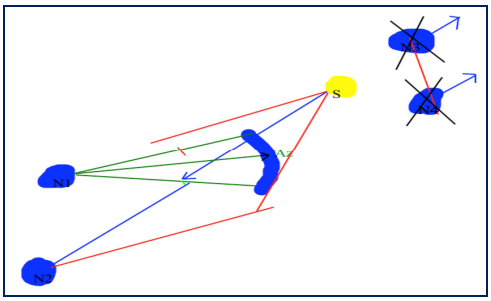
The objective of the algorithm is to optimize uplink interference and SINR, starting by means of RF parameter changes and then with RET changes which help reduce overshooting in addition to uplink and downlink inter-cell interference. The AGLOCELL Uplink Interference algorithm determines the impact changes may have on coverage by utilizing AI to achieve a balance between acceptable coverage and interference levels. Utilizing AI based intersection procedures and multivariate linear regression based historical training to guarantee an optimal radius. In addition, the algorithm utilizes AI to determine if a small impact on cell coverage may be acceptable in an urban area where the site density is high. SINR is degraded when interference levels are high, reducing overall system performance.

Uplink interference can be relatively high also due to inaccurate RF planning which may result into poor cell dominance. The issue is most likely to be present in urban areas where the site density is high and UEs are relatively close to neighboring gNBs/eNBs. Uplink interference may also be caused by RAN features such as Proactive Scheduling and Intra-Frequency Load Balancing. These features increase inter-cell interference to help meeting other objectives such as reduced latency and load balancing.

Downlink reference symbols are used by the UE for channel estimation and cell measurements (Level, Quality) for mobility. The gNB/eNB supports relative RS/PDSCH power control settings which the algorithm optimizes. The algorithm utilizes AI to optimize relative offset between the PDSCH and RS which is configured by

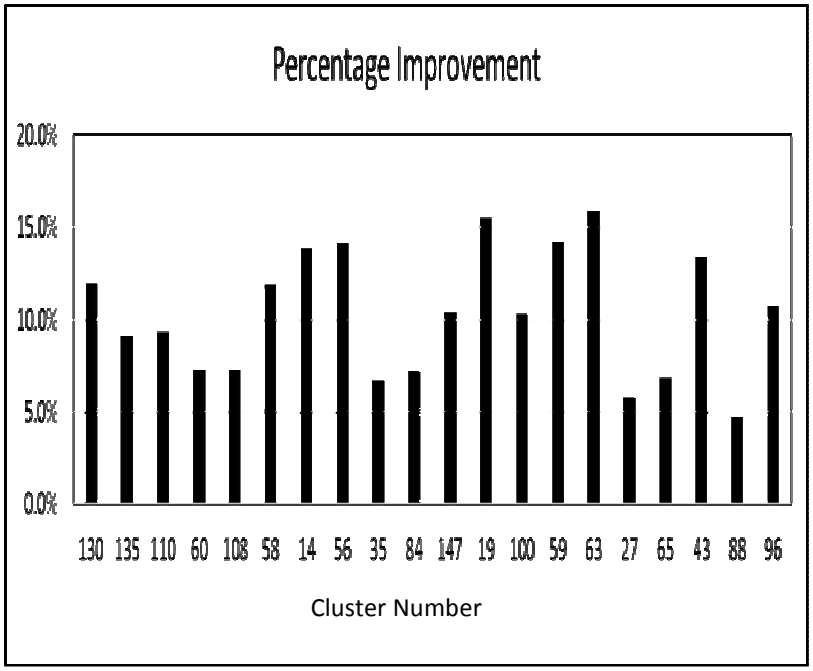
OA&M on cell level. The algorithm ensures that total Tx power is not exceed. The algorithm verifies the sum power for any OFDM symbol must not exceed the committed maximum power, otherwise all the configured boosts (PHICH) may not be applied. AGLOCELL optimizes transmission power of the downlink reference signals in a cell utilizing AI to boost (positive value) or respectively de-boost (negative value) compared to PDSCH.

The patent pending AI based algorithm determines which cells have uplink Interference, SINR or coverage issues that has at least one close neighbor sector. In addition, the algorithm determines if the two segments, identified by two lat/long coordinate pairs, intersect at one point.



The figure above shows the intersection of common coverage with source cell(s). In addition the AI based algorithm detects conditions where coverage intersect with parallel azimuths.

Case study results show a SINR improvement of between 8% and 18% in a large metro market focusing on clusters with high SINR. The chart to the upper right highlights the improvement on a cluster by cluster basis accomplished during the SINR optimization project.



AGLOCELL Uplink Interference Advantages

The AGLOCELL Uplink Interference algorithm benefits include:

- It was shown that RAN cells with interference over a predetermined threshold degrade the overall system performance.
- The AI based AGLOCELL Uplink Interference algorithm optimized uplink interference and SINR, by means of RF parameter and tilt changes.
- The AGLOCELL Uplink Interference algorithm improved SINR by 8% - 15% providing a corresponding increase in end user throughput and network capacity.

www.aglocell.com