only NB-IoT cells (reference signals no PRS) due to large cells site.

Using the proposed algorithm, the error in detection the Tn location reduced to (22, 10.1) from (43, 17.5) in scenario 1a, once the LTE D2D relay nodes are introduced. Here initial guess of the Tn location is taken as the one detected using NB-IoT nodes.

We have applied the proposed algorithm and captured the results with scenario 1b under which only LTE relay nodes are used and NB-IoT coverage is not available.

In scenario 1b, simulation results show more inaccuracies as compare to 1a (from (22, 10.1) to (23.5, 12.1)), due to the absence of NB-IoT nodes and inaccuracy at LTE-D2D location propagated while calculating the position at target node.

5. CONCLUSION AND FUTURE WORK

In this paper, the indoor positioning of the target node (NB-IoT and D2D capable) using NB-IoT and LTE-D2D relay nodes is proposed and studied. While proposed method (Taylor expansion and steepest descent method: forced non-linearization) enables indoor positioning for the weak or isolated node, at the same time, relay node positioning inaccuracies have been propagated to target node resulting errors in the position coordinates of the target node. This inaccuracy can be addressed by choosing best LTE-D2D relay nodes while calculating positioning for the target node. Our future work involves usage of unscented particle filters to mitigate the inaccuracy caused due to the LTE D2D relay mechanism and mobility aspects.

References

[1] https://docs.fcc.gov/public/attachments/FCC-15-9A1.pdf

[2] 3GPP, TR 37.857- Study on indoor positioning enhancements for UTRA and LTE Release 13

[3] http://www.rfwireless-world.com/Terminology/OTDOA-basics-and-OTDOA-working-in-LTE.html

[4] http://www.rohde-schwarz-wireless.com/documents/LTELBSWhitePaper_RohdeSchwarz.pdf

[5] http://d2d-4-5g.gforge.inria.fr/Workshop-June2016/slides/Overview_LTE_D2D.pdf

[6] RP-151621, NB-IOT, QualComm, 3GPP TSG RAN Meeting #69, Phoenix, USA, Sep. 14 - 16, 2015

[7] Lepaski, Novel Methods for Personal Indoor Positioning. ISBN (electronic: 978-952-15-3612-0) Tampere university

[8] Eric wan, "The unscented kalman filter" https://www.seas.harvard.edu/courses/cs281/papers/unscented.pdf

[9] Gustafsson Particle Filters for Positioning, Navigation and Tracking. IEEE Transactions on Signal Processing, Feb 2002

[10] Agassi Melikov, Cellular networks positioning performance analysis reliability. InTech 2011 ISBN-13:9789553072463