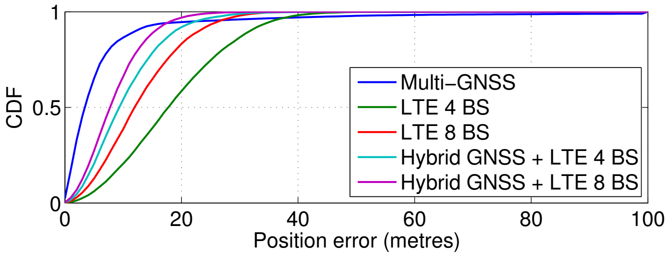
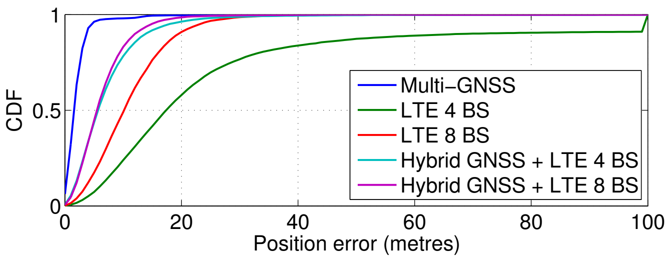
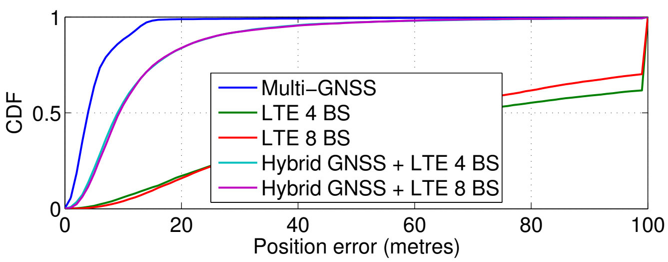


(a) 2D position error with GRS observables, ratio 1:1 and LTE HDOP < 2



(b) 2D position error with field observables



(c) 3D position error with field observables

Fig. 7. Position accuracy of GNSS, LTE and the hybrid approaches.

VI. Conclusions

This work assesses the hybrid positioning performance of Global Navigation Satellite Systems (GNSS) and Long Term Evolution (LTE) cellular systems in urban scenarios. A simple and generic methodology is proposed to evaluate the hybrid approach, by representing an urban environment with a certain elevation mask and real LTE base station (BS) locations. The proposed model is assessed with field GNSS observables and simulated LTE ranging measurements. The results show that the multi-constellation GNSS performance is mainly limited by satellite visibility, while the LTE positioning accuracy is mainly bounded by multipath. Assuming a LTE bandwidth of 10 MHz and outdoor urban scenarios, multi-GNSS achieves the best position accuracy, while LTE and the hybrid approach obtain a full position availability, being the hybrid solution more accurate than LTE stand-alone. Further enhancements of the hybrid solution should be considered for accurate and robust localization within future 4G and 5G applications.

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