UltraChronic: Tracking multiple single frequency emitter Simultaneously

NEC Labs China

***Abstract*—Although positioning by ultrasound pulse is not fairly new as research problem, there are still some open issues on this topic. In this paper, an interesting issue, that how to locate multiple ultrasound transmitters simultaneously, is addressed. The challenge of this issues come from two folds. Firstly, Two pieces of ultrasound pulse, if overlapped at receiver end, will not be separated efficiently. Secondly, two piece of ultrasound pulse, even not overlapped, can not be distinguished from the receiver end. This To solve this problem, a novel positioning method named UltraChorus is proposed. In UltraChorus system, we allow more than one emitter to send ultrasound pulse simultaneously and try to locate them separately. After emitting, a set**

of distance measurements with unknown-origin is obtained by receivers, which are required to match to each transmitter. To solve this optimal match problem, we proposed a cluttering algorithm named Density-Ball to find an approximate solution. This algorithm is designed with an obvious intuition, that positioning results produced by any subgroups of distance measurement from the same transmitter are close to each other. The position of transmitters can be estimated by the center of each local density center in 3D space containing all positioning result. UltraChorus is implemented and evaluated in both simulation and demo system. It is verified that, the positioning accuracy of UltraChorus is close to the system running TDMA protocol without loss of refresh-rate. To adapt to the real environment, how measurement error, caused by NLOS propagation and overlapping of ultrasound pulse, affect the accuracy of UltraChorus is analyzed.

I. Introduction

In ultrasound pulse based positioning system, two or more ultrasound transmitters are not allowed to emit pulse at the same time, because the source of the ultrasound pulse is not distinguishable after emitting. Previous ultrasound pulse based positioning systems, such as bat and cricket, are designed according to this principle, in which transmitters are working in TDMA protocol. The drawback of this design is that refresh-rate drops linearly when number of transmitter increases. As a result, the number of concurrent positioned targets is limited.