Indoor Localisation using Broadband Ultrasound

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1 Introduction

Accurate, real-time indoor location-sensing systems have typically involved a high density of fixed, centrally-controlled nodes. This infrastructural requirement is one reason such systems have not seen a high proliferation.

We aim to develop an indoor location system that is accurate yet easy to deploy ad hoc in order to facilitate leading-edge location-aware computing.

Ultimate goals:

- unhindered scalability through multiple access
- centimeter-level accuracy
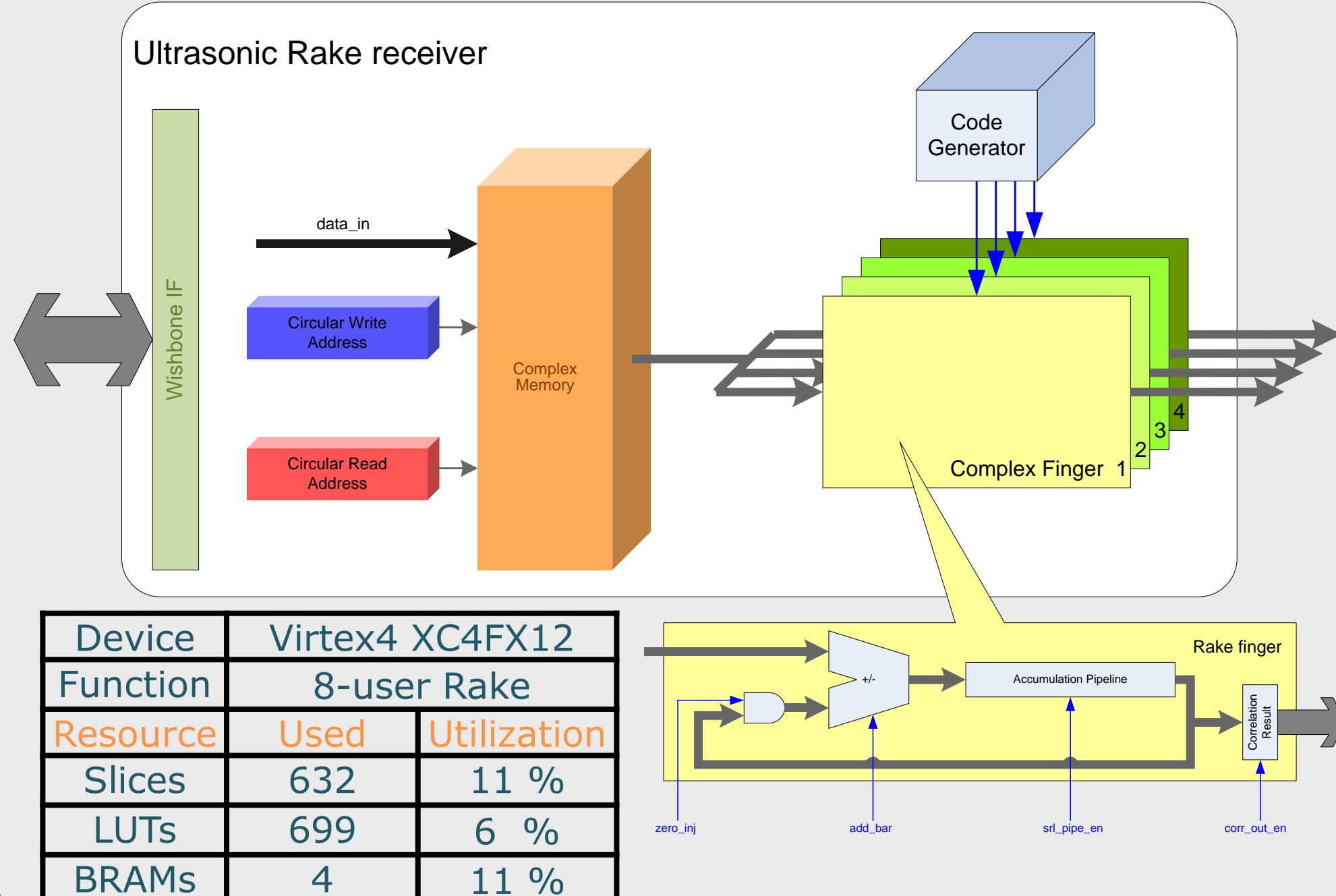- additional context: velocity and orientation

2 Hypothesis

We will combine spread spectrum **broadband ultrasound** and array signal processing techniques with bespoke hardware architectures as to realize small devices which can be worn by people or attached to objects.

These tags will allow us to infer **position**, **speed**, and **orientation** so that location-aware applications can use richer physical models boosting perceived accuracy and possible interaction schemes.

This will help in demanding scenarios such as spontaneous interaction and real-time navigation.
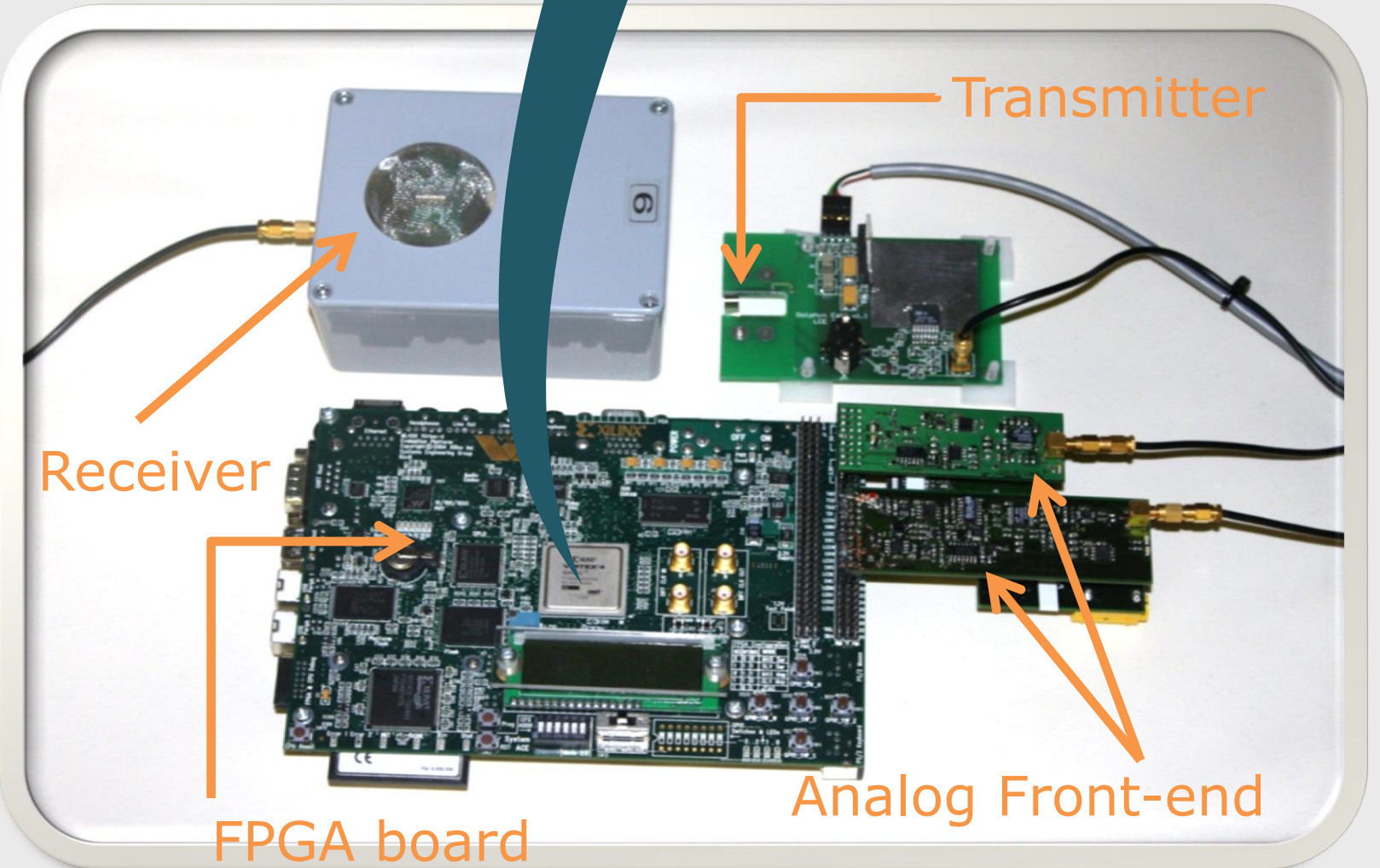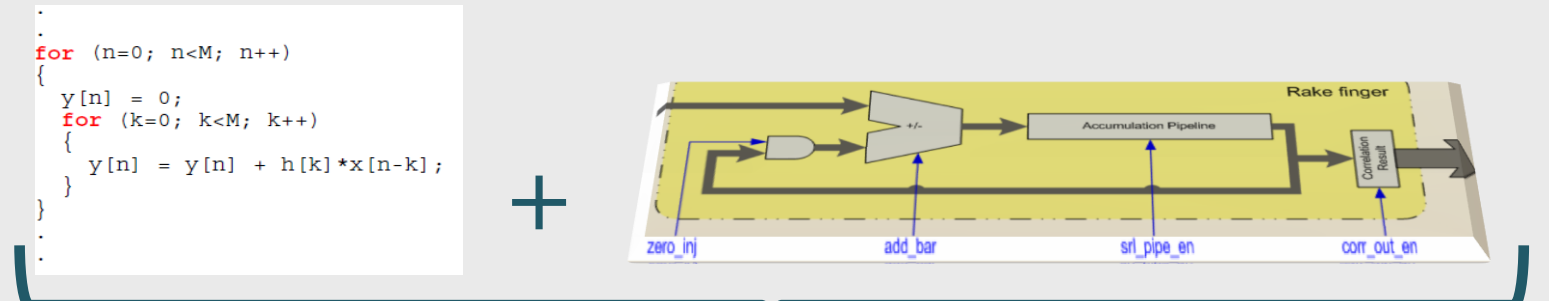
3 Ranging Engine

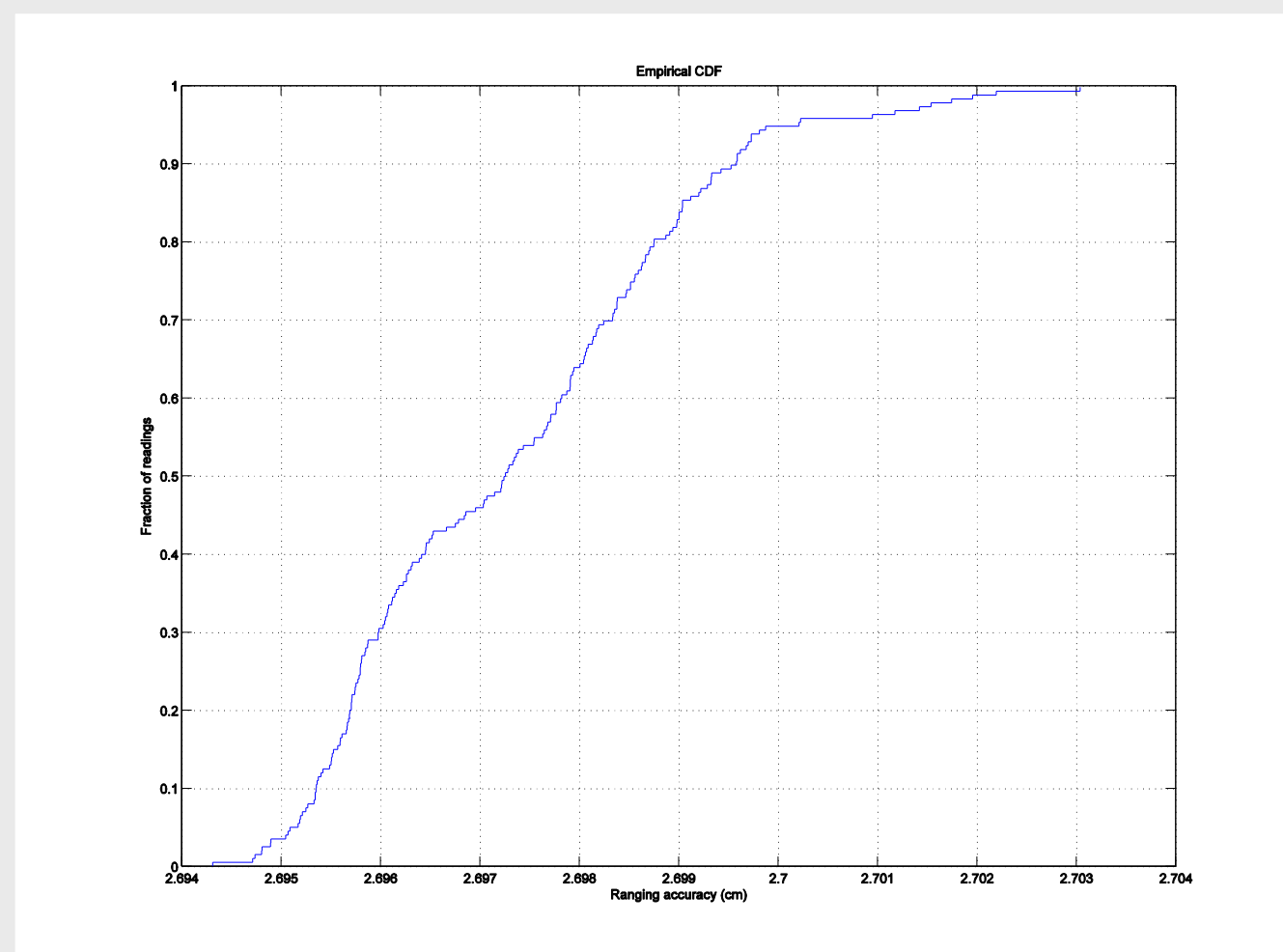| Device	Virtex4 XC4FX12	
Function	8-user Rake	
Resource	Used	Utilization
Slices	632	11 %
LUTs	699	6 %
BRAMs	4	11 %

4 On the Agenda

- Tracking a user indoors through the **Doppler effect** in order to infer speed
- Deducing Angle-of-Arrival by means of **beamforming**

5 Prototype

Transmitter
Receiver
FPGA board
Analog Front-end

6 Accuracy Evaluation*

* This metric is a multiple access cumulative distribution plot i.e. simultaneous ranging signals