Evaluation of neural network-based multipath mitigation approach for the GNSS receivers

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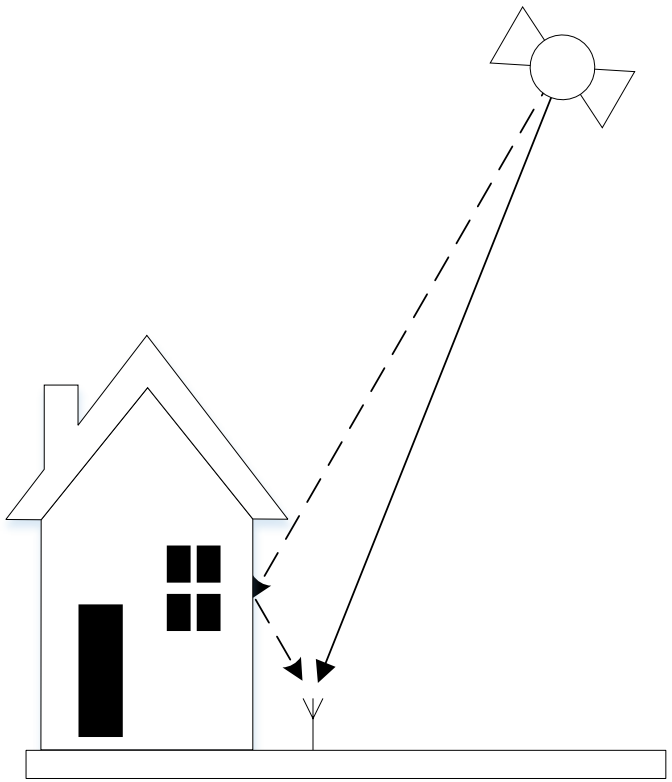
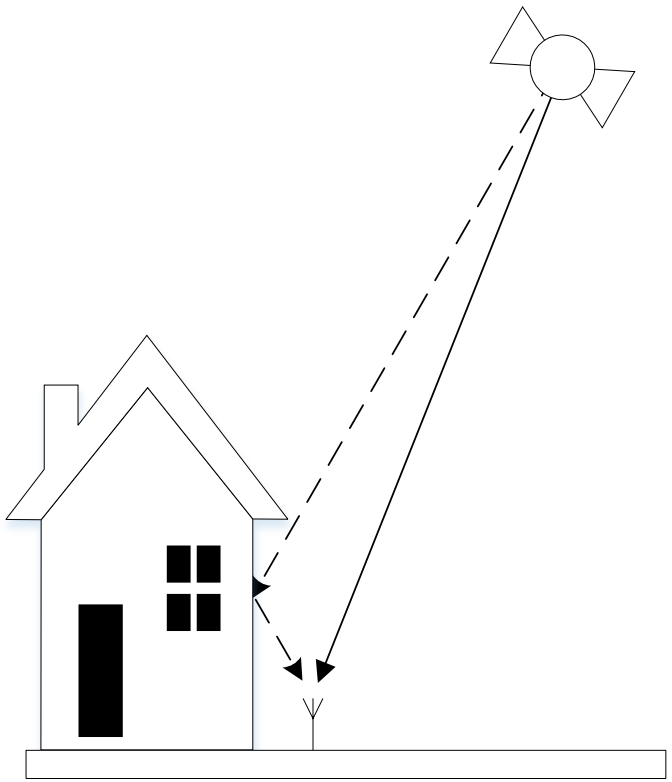
Error sources



Source	Error, meters	Mitigation method
Satellite clock	±2	
Satellite orbit	±2.5	
Atmosphere	±5	
Receiver noise	±0.5	
Multipath	±1	

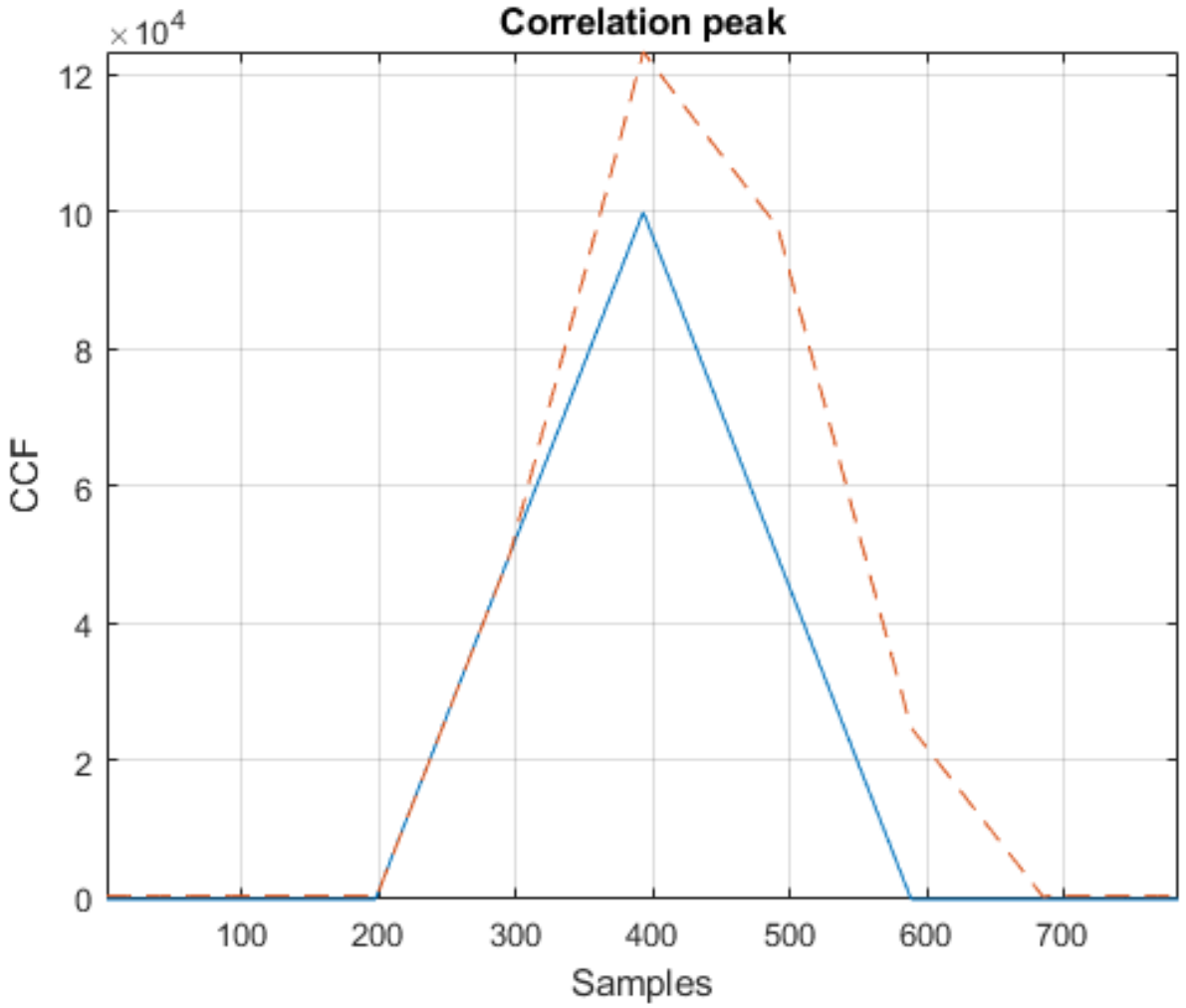
Error sources



Source	Error, meters	Mitigation method
Satellite clock	±2	RTK, PPP
Satellite orbit	±2.5	RTK, PPP
Atmosphere	±5	RTK, PPP-AR
Receiver noise	±0.5	Receiver quality improvement
Multipath	±1	—

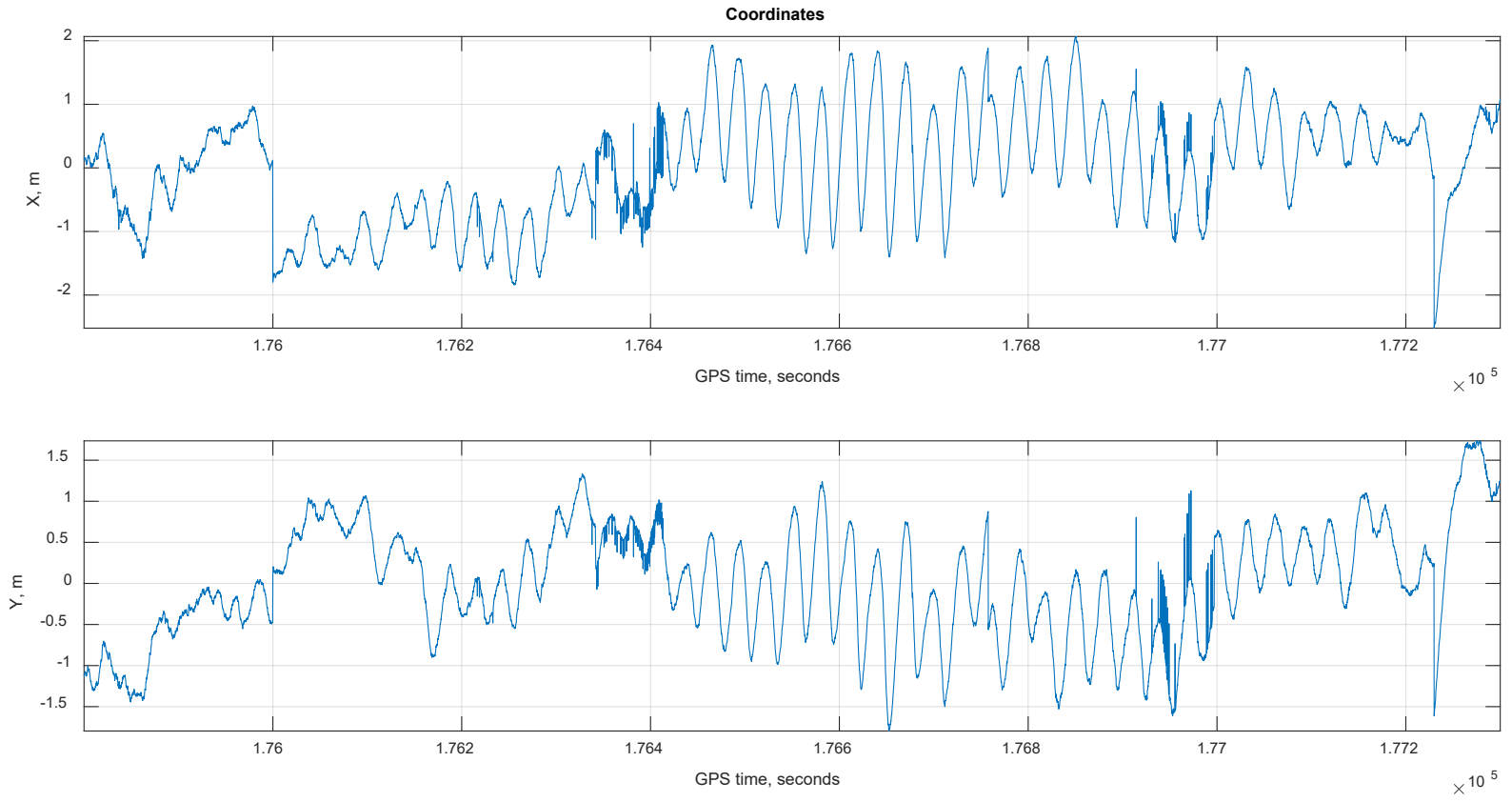
Influence of multipath

1. Plurality of reflected signals at the input of the receiver
2. Reflected signals depend on the surroundings and the dynamics of the receiver
3. Tracking errors



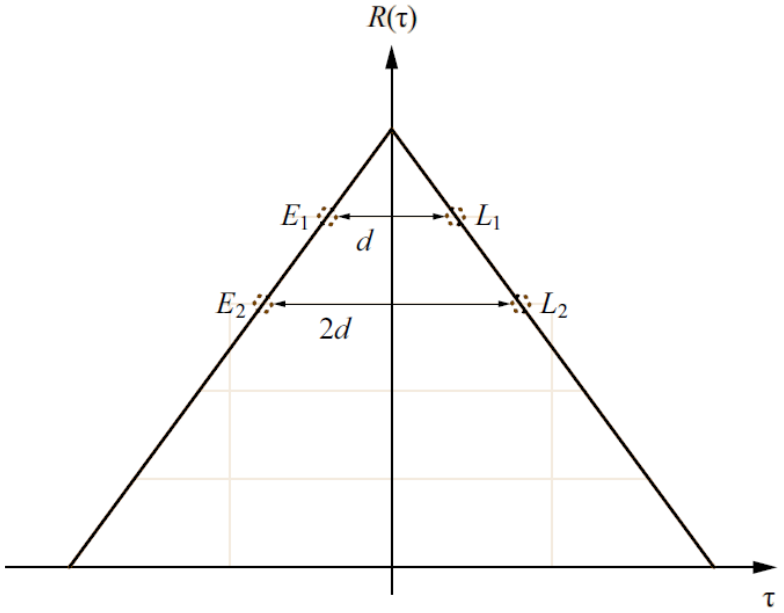
Influence of multipath

1. «Raw» measurements errors
2. Oscillated nature of the calculated position with heavy multipath



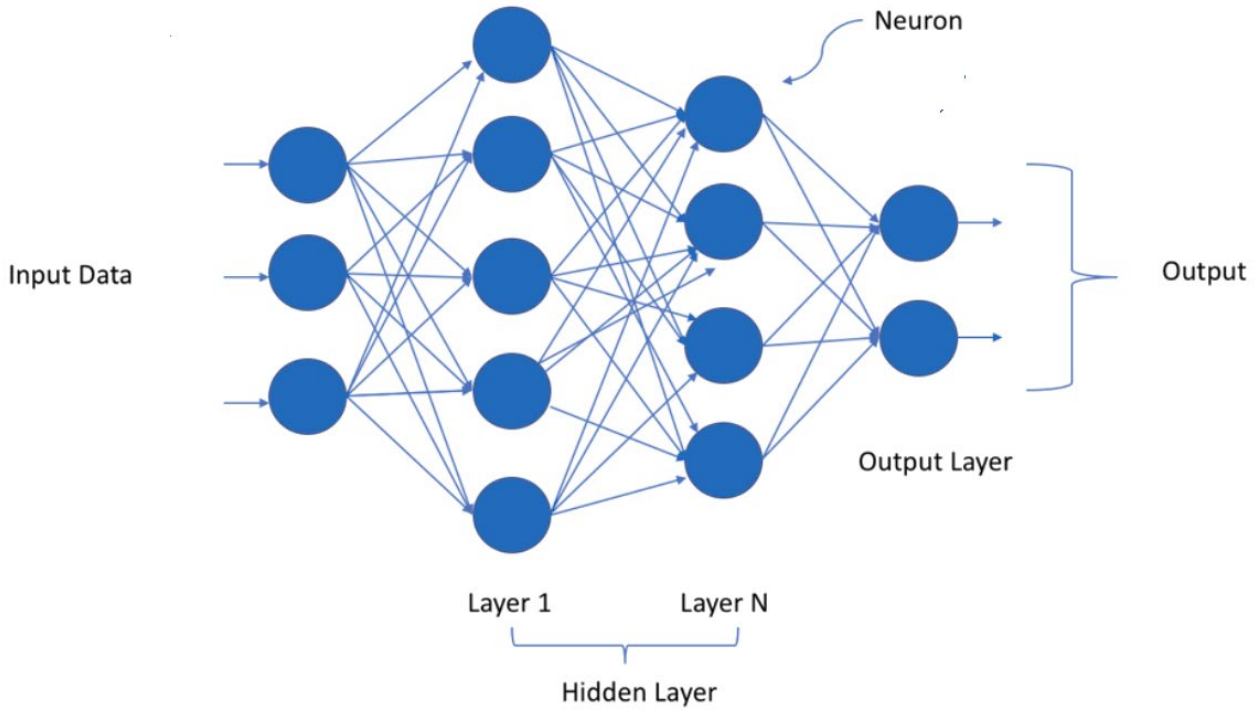
Mitigation approaches

1. Special antennas (pattern-shaping)
2. Non-parametric correlation methods
3. Parametric (estimating) methods



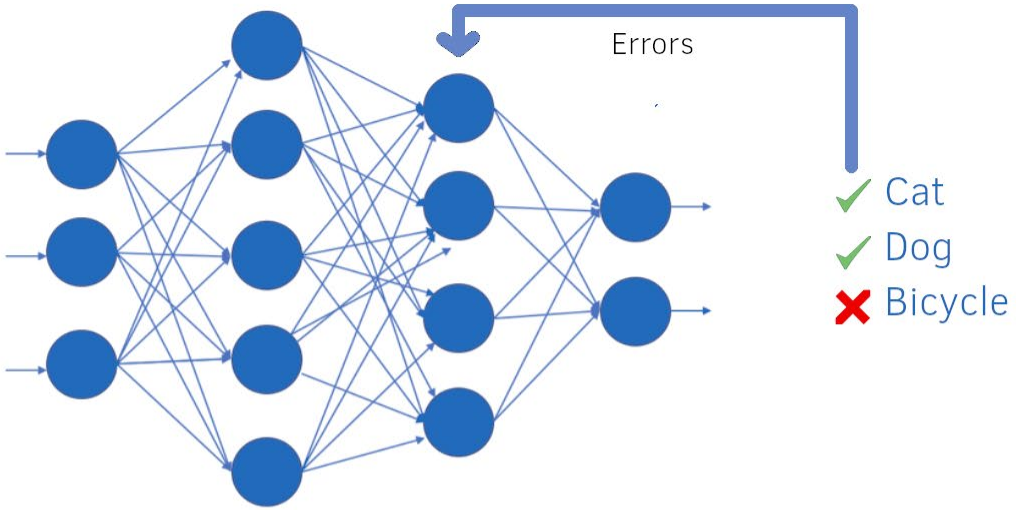
Neural networks 101

1. Neural networks consists of layers, each layer has numerous neurons
2. Each neuron performs a fused multiply-accumulate operation with a non-linear activation

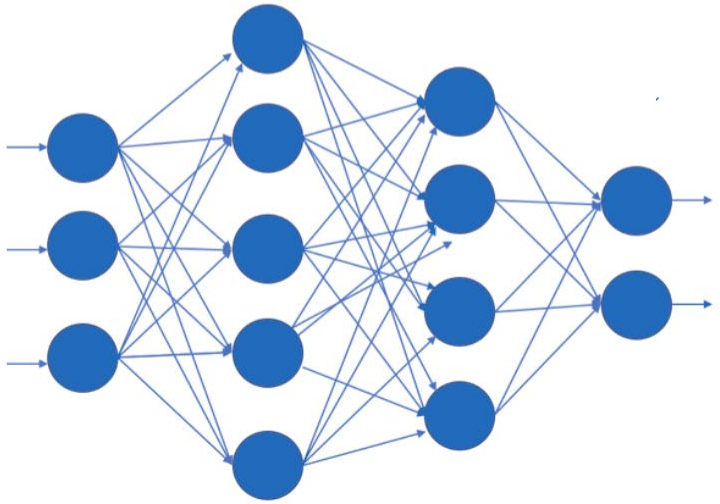


Neural networks 101

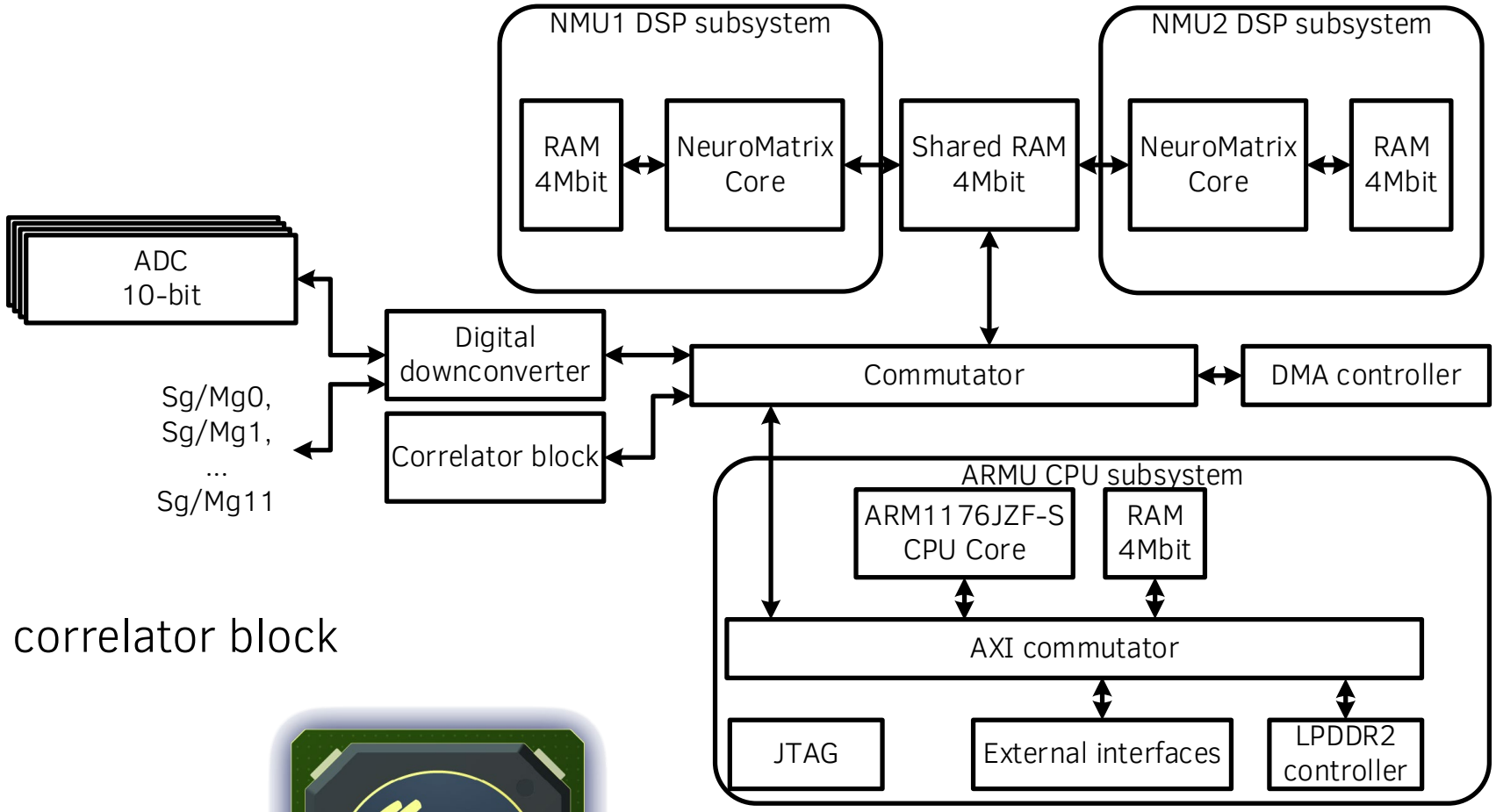
Train:



Deploy:



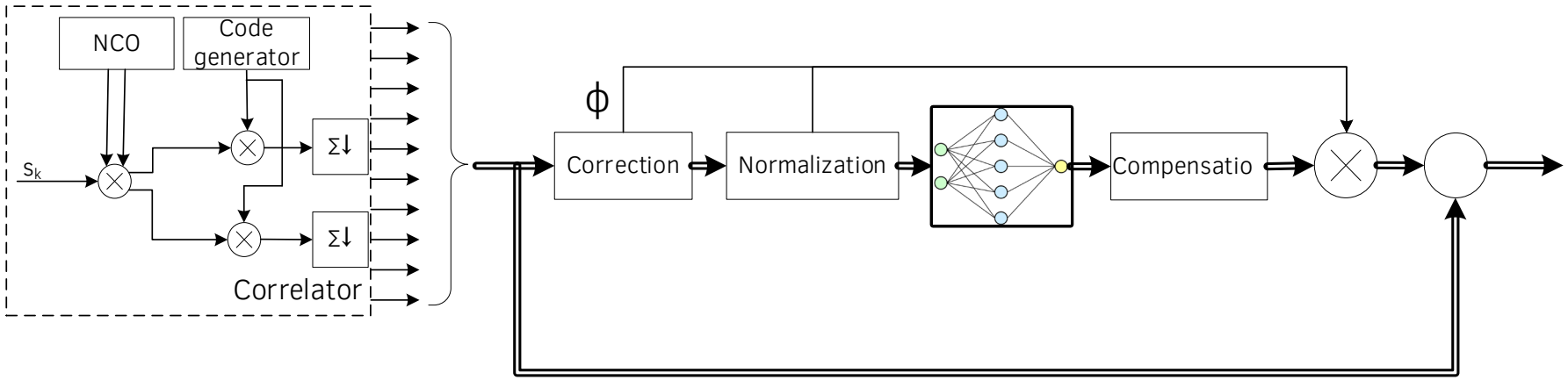
BBP2 SoC (K1888BC018)

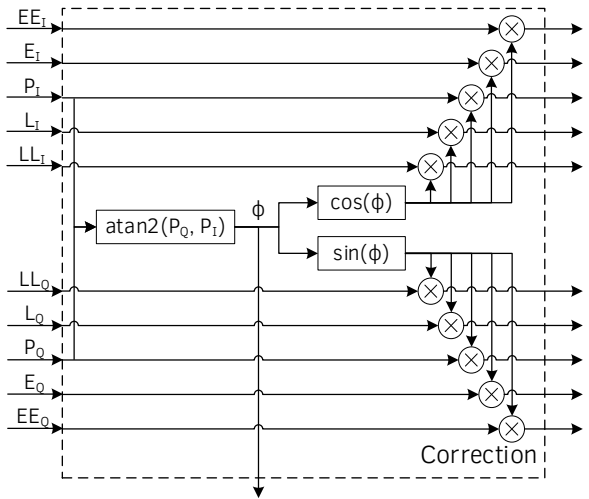


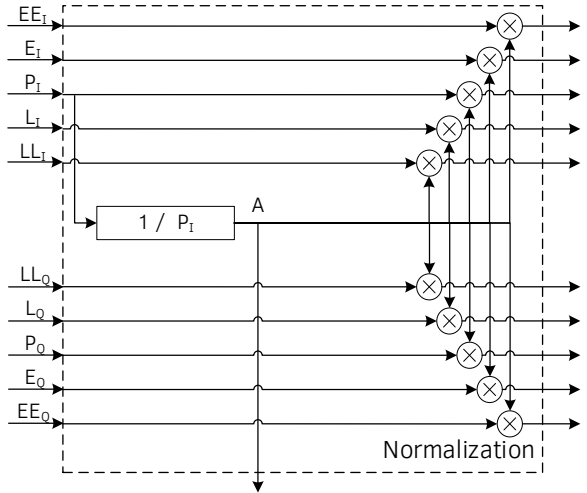
1. Built-in 10-bit ADCs
2. Hardware (co-processor) correlator block
3. 2 DSP NeuroMatrix cores
4. ARM CPU Core

Neural network-based method

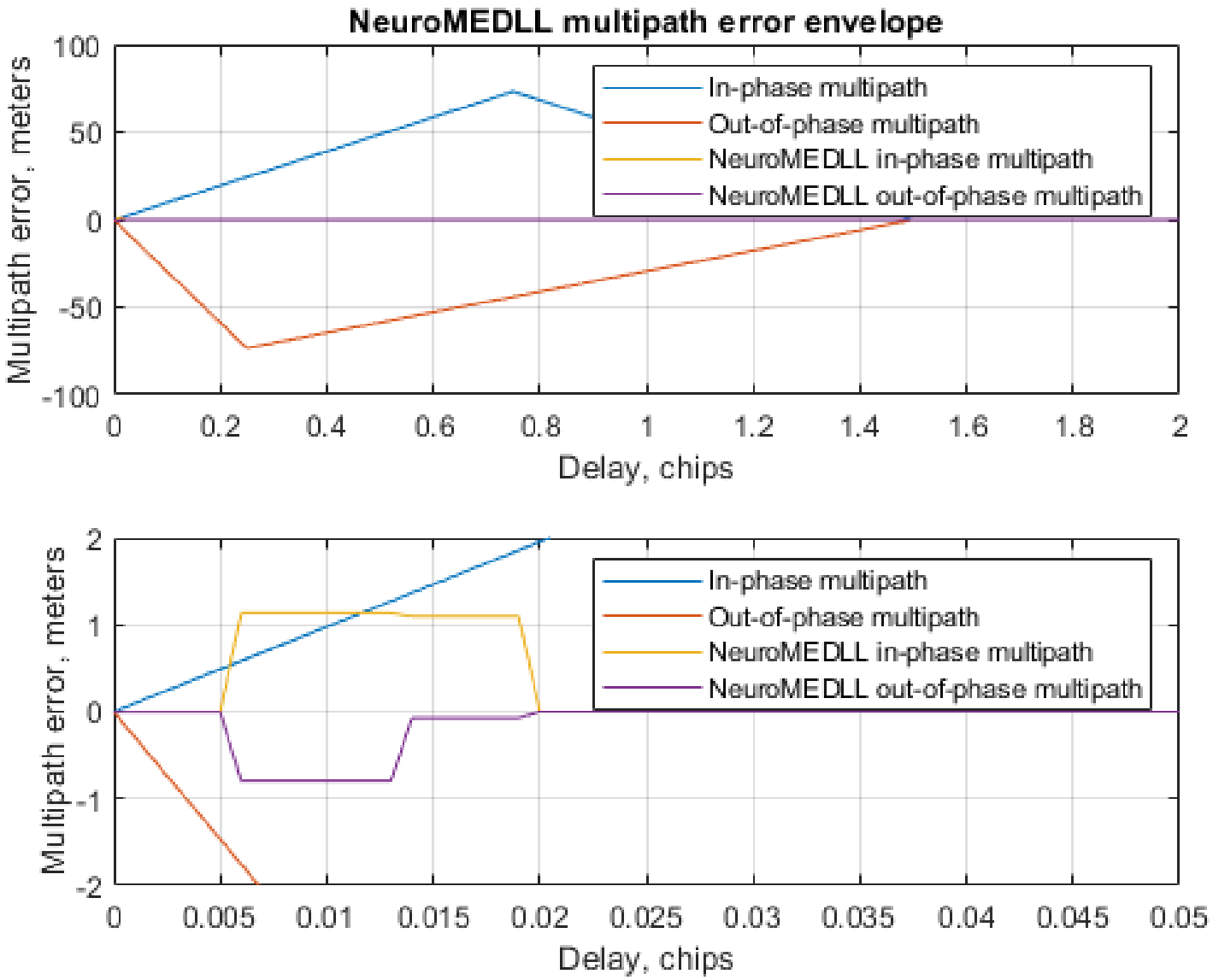
1. Uses five-tap correlator
2. Estimates the parameters (relative amplitude, delay, phase) of up to three reflected signals
3. Has a moderate computational complexity







Multipath error envelope



Thank you for your attention

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