Introduction to Traditional MLSE Algorithm

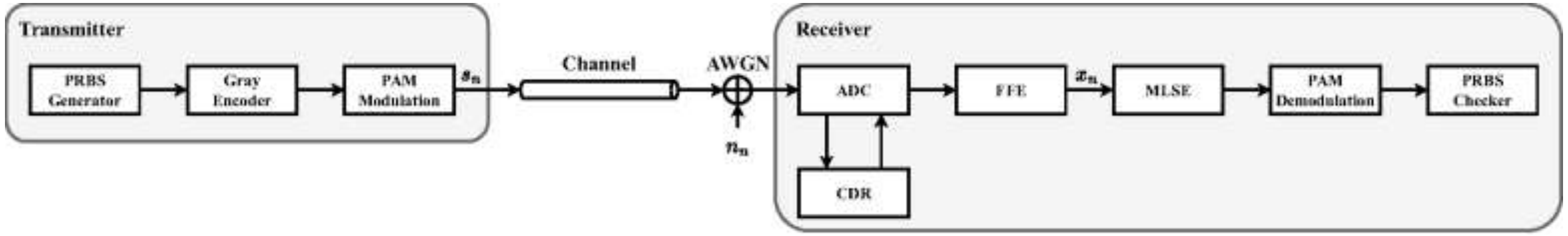

Fig. 1. Schematic diagram of the transceiver model with MLSE.

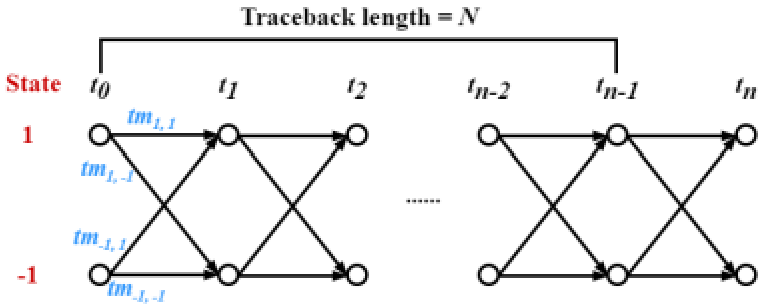

Fig. 2. Trellis diagram for NRZ signaling (traceback length = n).

- MLSE is currently considered the optimal equalizer.
- DFE has lower complexity than MLSE.
- **However**, DFE suffers from significant error propagation, which is a notable drawback.

Although the Viterbi algorithm reduces MLSE complexity, its complexity and power consumption remain prohibitive.

#12 A low-complexity MLSE algorithm for the NRZ high-speed transceivers

Proposed MLSE and Results

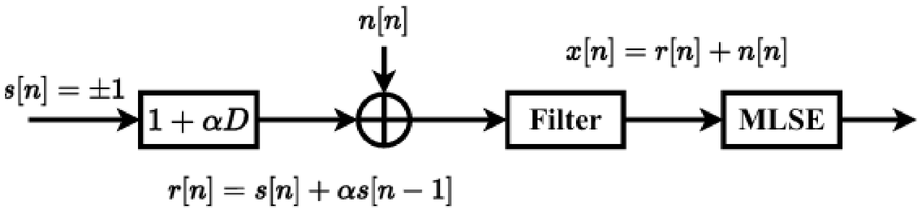

Fig. 3. Simplified system model diagram.

The proposed low-complexity algorithm still adheres to the core principle of MLSE, which is to minimize the value of Eq. (1).

$$\sum_{N} (x[n] - r[n])^2 \quad (1)$$
$$= \sum_{N} \left(x[n]^2 - 2x[n]r[n] + r[n]^2\right)$$
$$= \sum_{N} \{ \left(x[n]^2 + 1 + \alpha^2\right)$$
$$-2\left[x[n]\left(s[n] + \alpha s[n-1]\right) - \alpha s[n]s[n-1]\right] \} .$$

This proposed algorithm significantly reduces the cumulative computations compared to a traditional MLSE.

$$\Delta T[n] = \begin{cases} x[n] - \alpha & \alpha \le J \\ -\Delta T[n-1] + (1-\alpha)x[n] & -\alpha \le J < \alpha \\ x[n] + \alpha & J < -\alpha \end{cases} \quad (2)$$

J is $\Delta T[n-1] + \alpha x[n]$

TABLE I

RESOURCE UTILIZATION FROM QUARTUS.

Resource	Proposed MLSE	Traditional MLSE	Reduction
ALMs	904.2	1490.3	39.32 %
Combinational ALUTs	630	1114	43.45 %
Registers	1415	2304	38.59 %
DSP Blocks	4	12	66.67 %

Significant reductions were achieved in all resource consumption aspects, ranging from a minimum of 38.59 % to a maximum of 66.67 %.

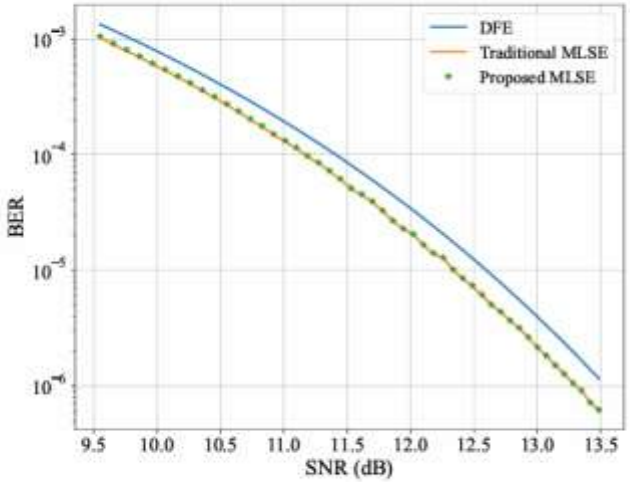

Fig. 4. Correspondence between the SNR and BER.

The proposed algorithm achieves resource savings while preserving performance integrity.

中国科学技术大学
University of Science and Technology of China