



**SNS COLLEGE OF TECHNOLOGY**  
**An Autonomous Institution**  
**Coimbatore-35**



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**19ECB212 – DIGITAL SIGNAL PROCESSING**

II YEAR/ IV SEMESTER

**UNIT 5 – DSP APPLICATIONS**

**TOPIC – APPLICATION OF ADAPTIVE FILTERS TO EQUALIZATION**



## ADAPTIVE FILTERS



- The term *Filter* is often used to describe a device in the form of a piece of physical hardware or software that is applied to a set of noisy data in order to extract information about a prescribed quantity of interest.
- An **adaptive filter** is a system with a linear filter that has a transfer function controlled by variable parameters and a means to adjust those parameters according to an optimization algorithm.
- An adaptive filter is one which can automatically design itself and can detect system variation in time.



## DEFINING AN ADAPTIVE FILTER



An adaptive filter is defined by four aspects:

1. The *signals* being processed by the filter.
2. The *structure* that defines how much the output signal of the filter is computed from its input signal.
3. The *parameters* within this structure that can be iteratively changed to alter the filter's input-output relationship.
4. The *adaptive algorithm* that describes how the parameters are adjusted from one time instant to next.



## ADAPTIVE FILTER



- The optimization criterion is a cost function, which is most commonly the mean square of the error signal between the output of the adaptive filter and the desired signal.
- As the filter adapts its coefficients, the mean square error (MSE) converges to its minimal value.
- At this state, the filter is adapted and the coefficients have converged to a solution.
- The filter output,  $y(k)$ , is then said to match very closely to the desired signal,  $d(k)$ .
- When you change the input data characteristics, sometimes called filter environment, the filter adapts to the new environment by generating a new set of coefficients for the new data.

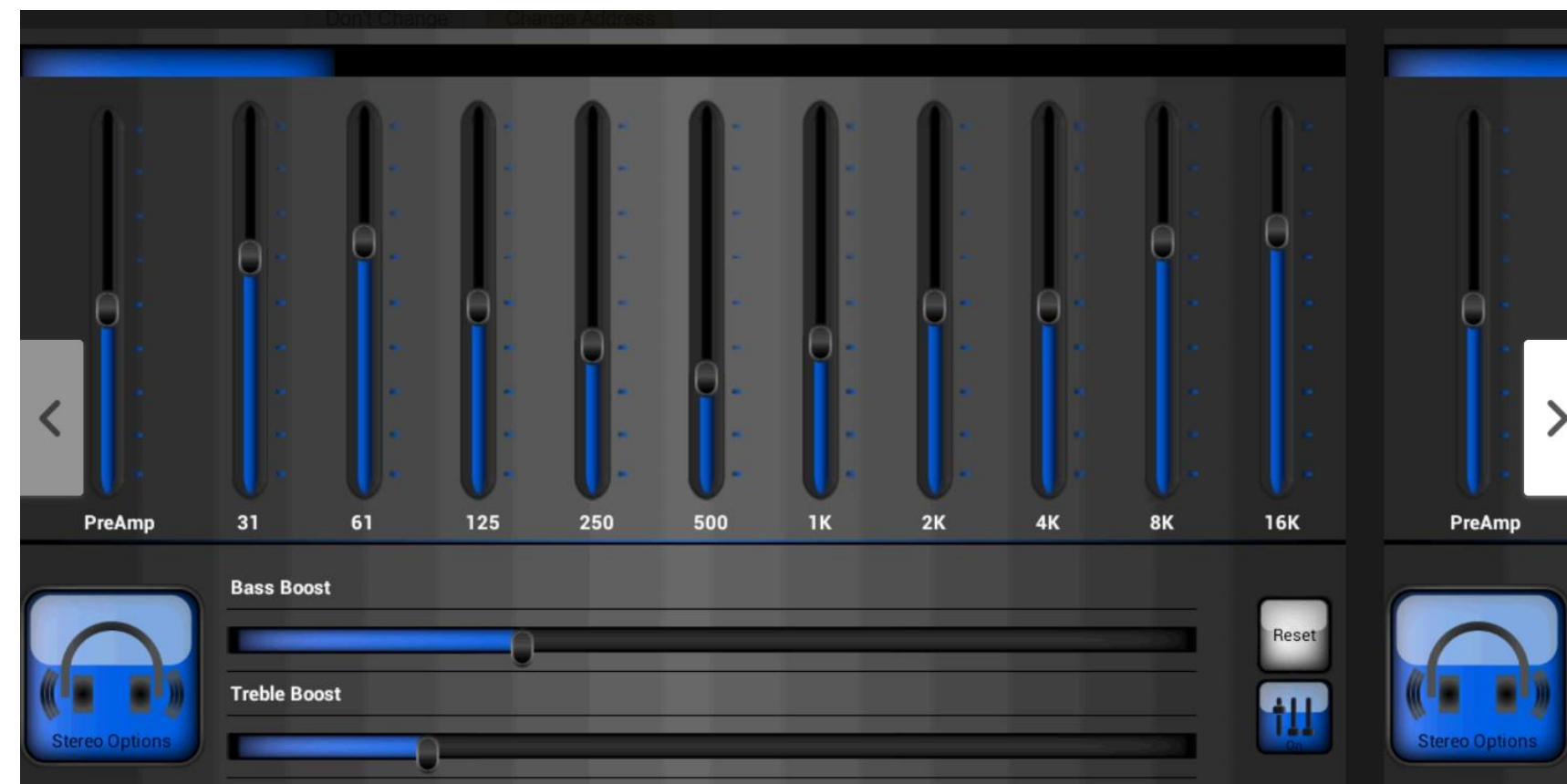


## ADAPTIVE FILTERS FOR EQUALIZATION



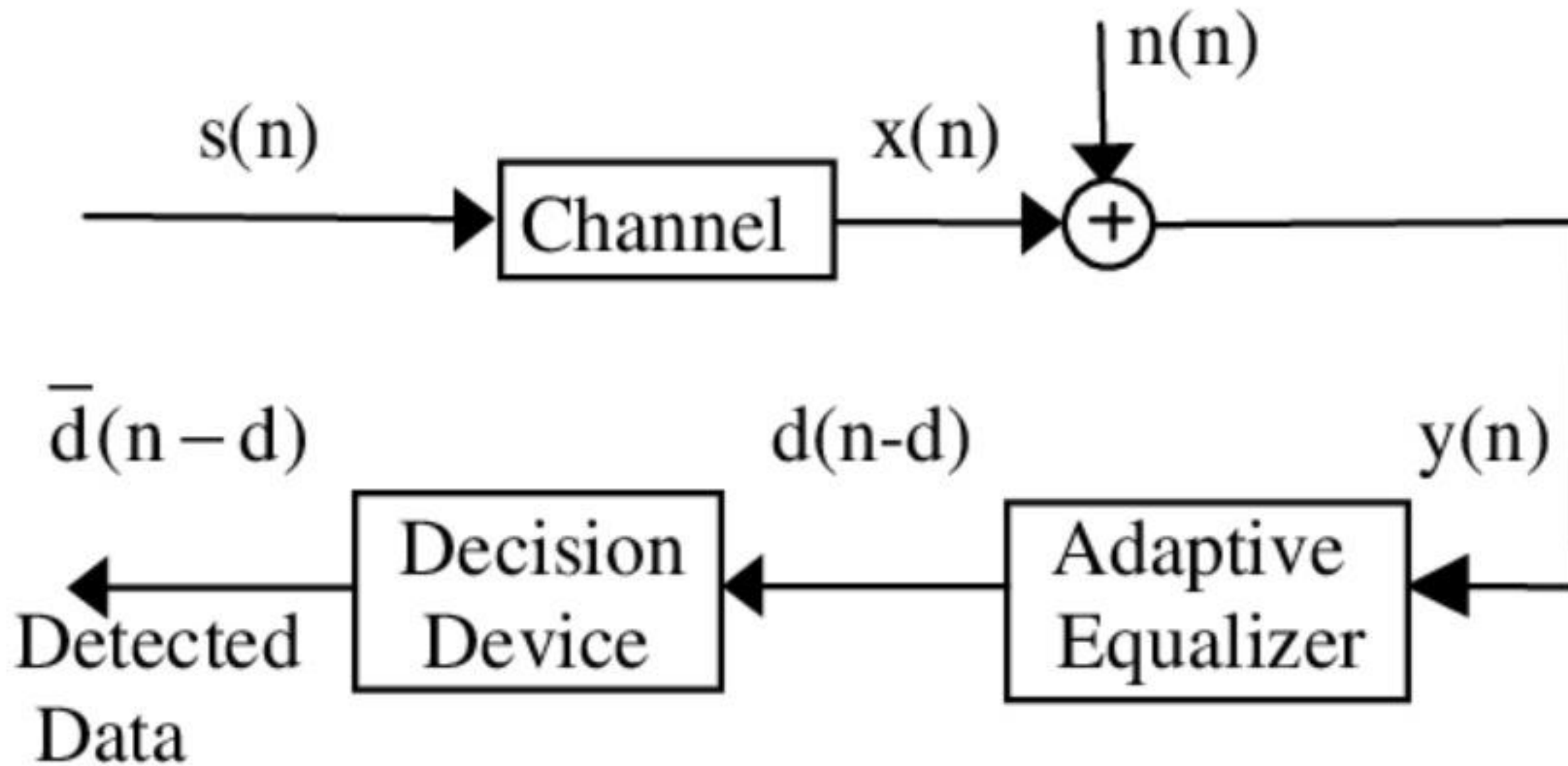
- **ADAPTIVE EQUALIZER:**

- An adaptive equalizer is an equalizer that automatically adapts to time-varying properties of the communication channel.
- This process is called adaptive equalization.
- The filter used for this process is Adaptive filter.





# ADAPTIVE EQUALISER





## APPLICATIONS OF ADAPTIVE FILTERS



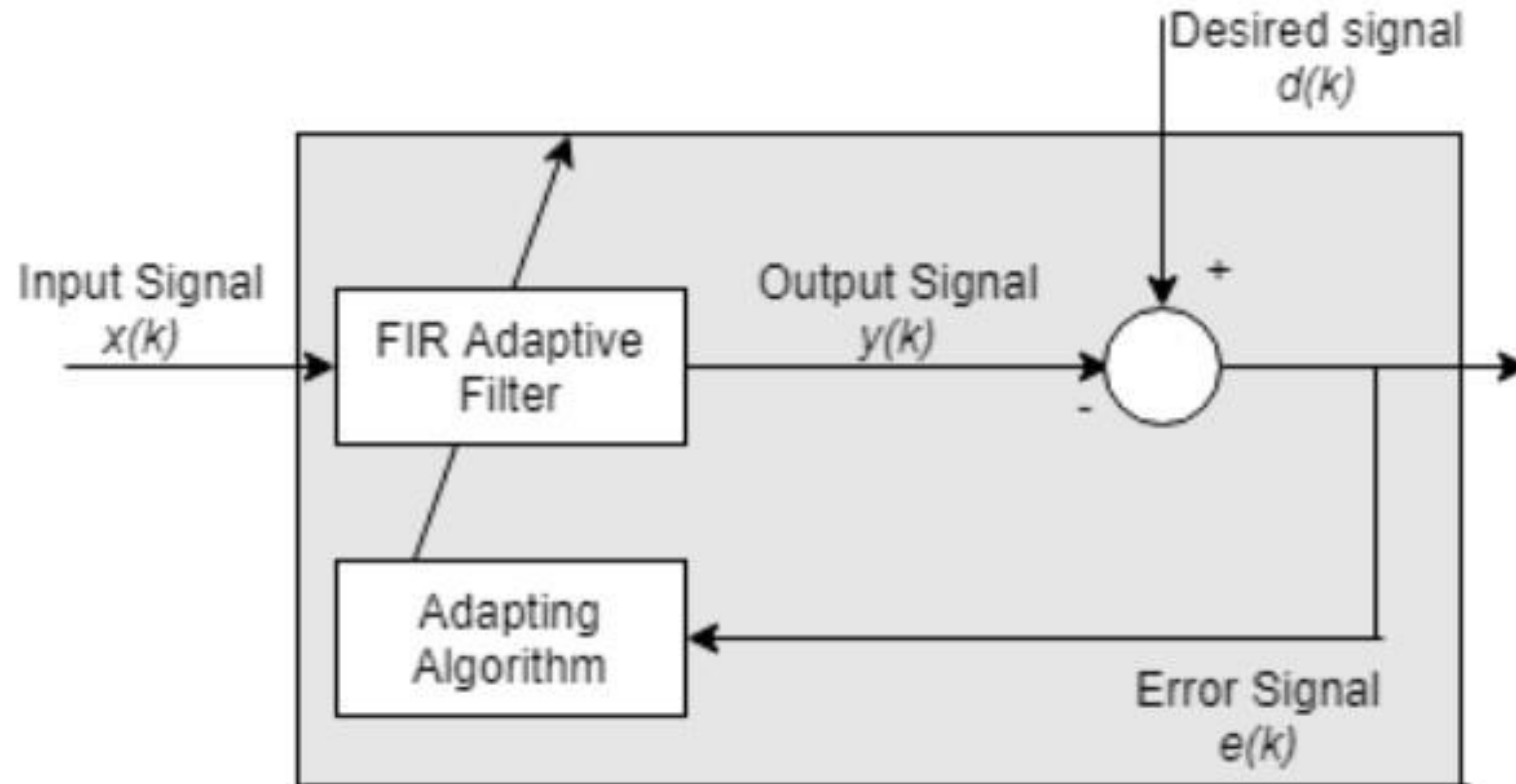
- **SYSTEM IDENTIFICATION:**

Using an Adaptive Filter we can identify an unknown system, such as the response of an unknown communications channel or the frequency response of an auditorium, to pick fairly divergent applications.

Other applications include echo cancellation and channel identification.



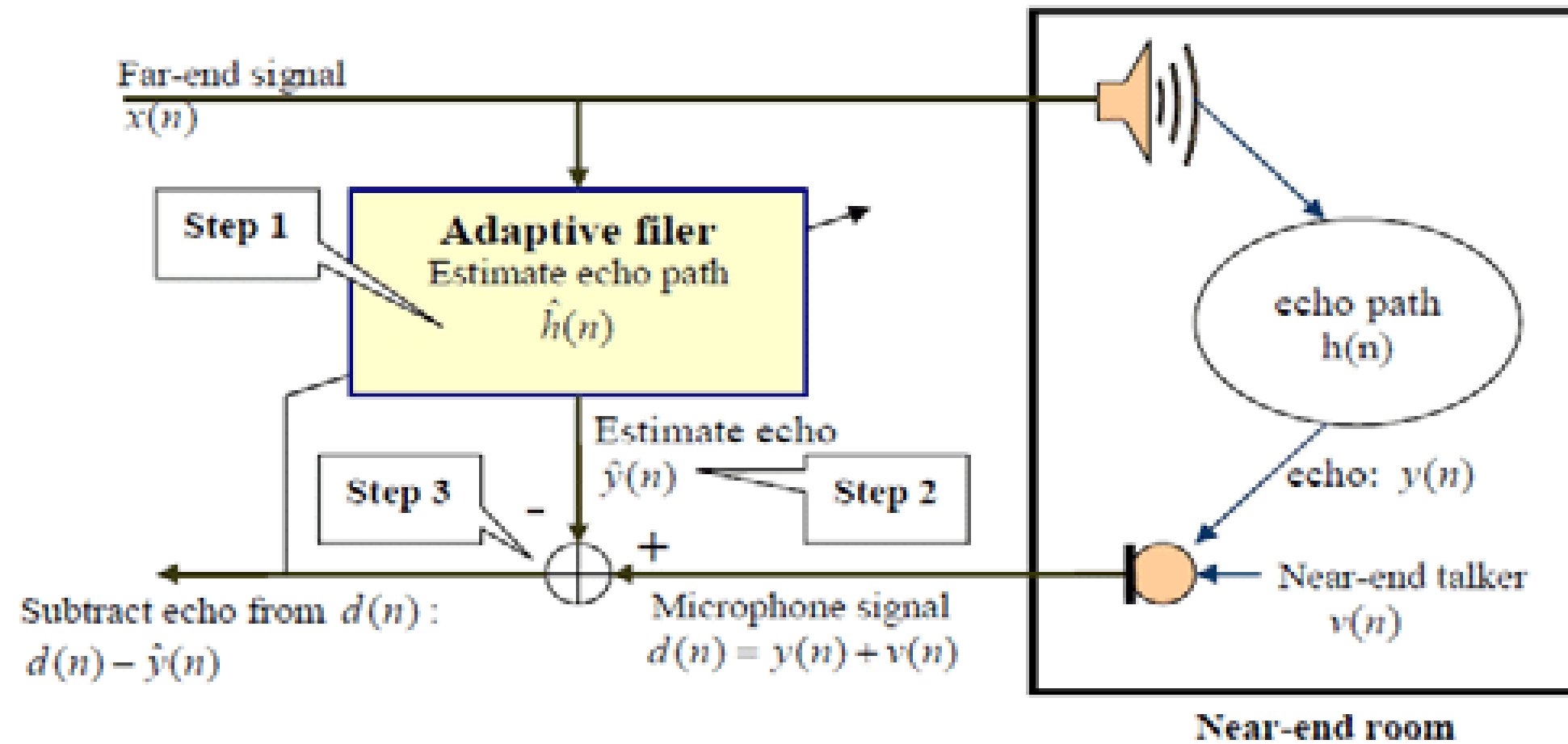
# APPLICATIONS OF ADAPTIVE FILTERS







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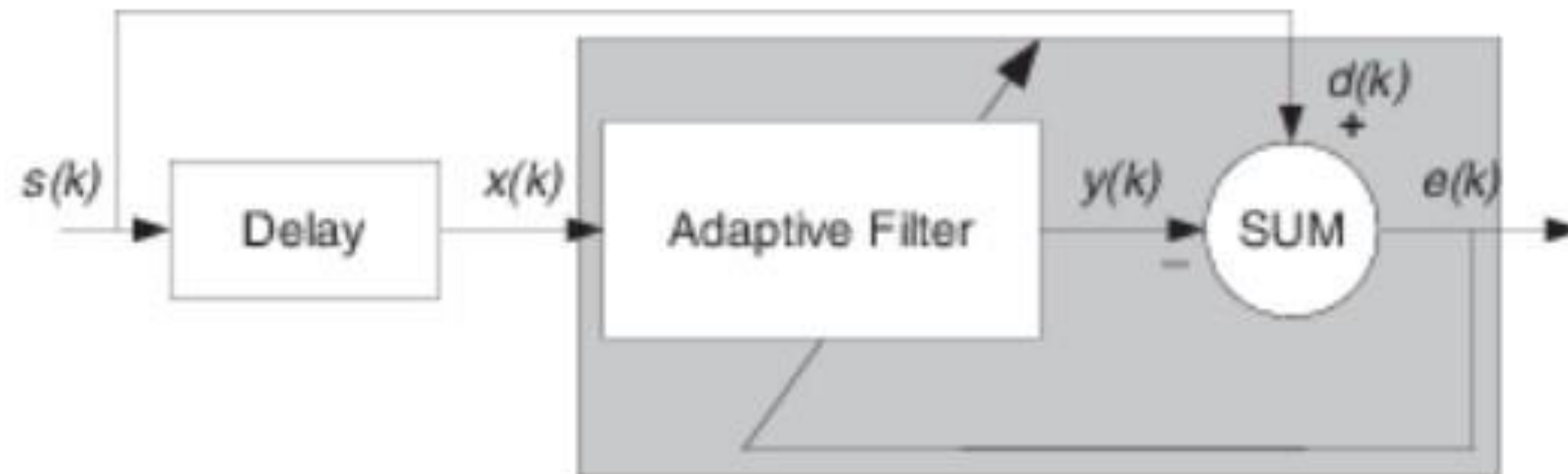


## APPLICATIONS OF ADAPTIVE FILTERS



- **PREDICTION - - Predicting Future Values of a Periodic signal:**

Predicting signals requires that you make some key assumptions. Assume that the signal is either steady or slowly varying over time, and periodic over time as well.



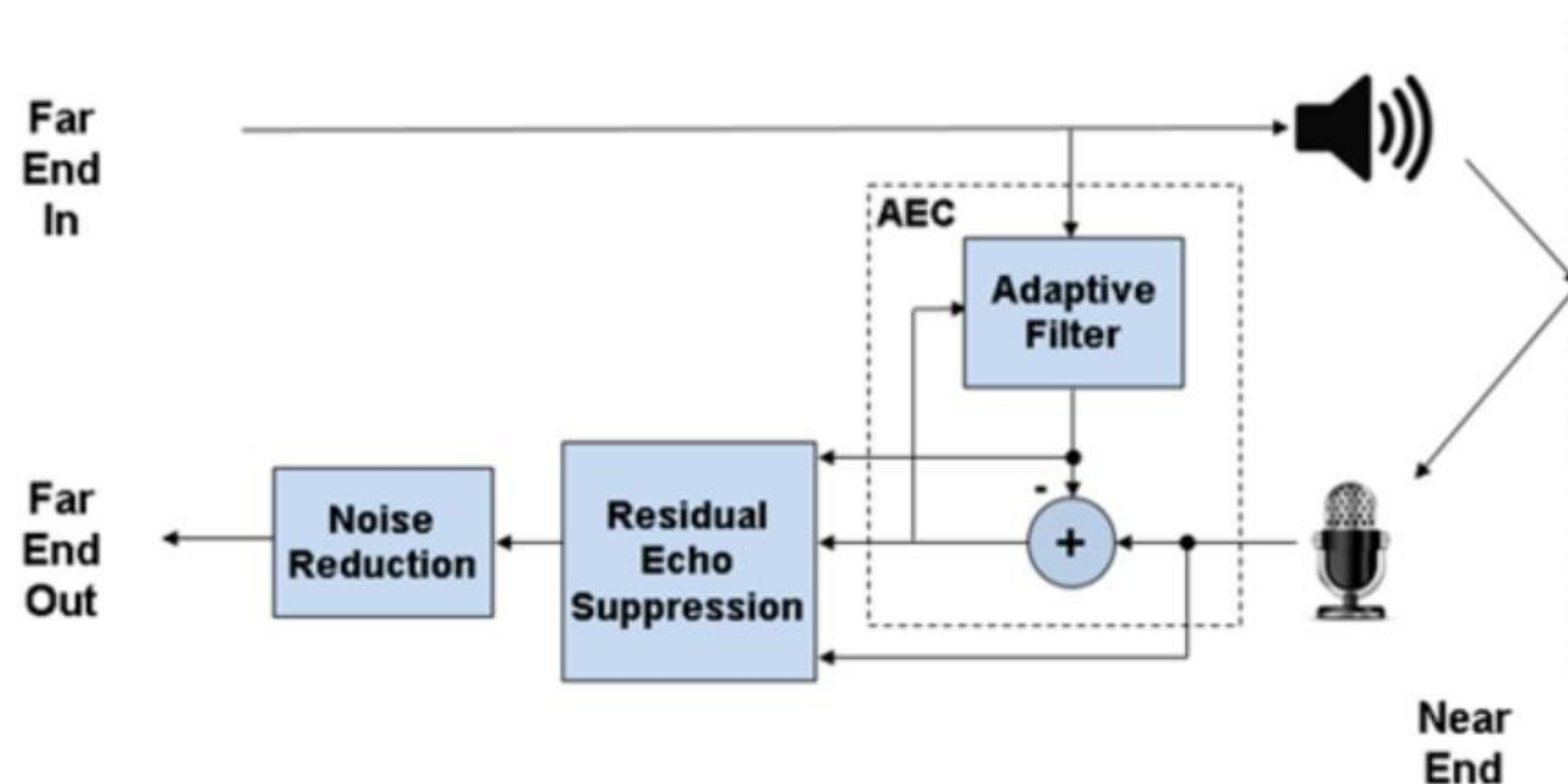


# APPLICATIONS OF ADAPTIVE FILTERS



- **NOISE OR INTERFERENCE CANCELLATION:**

In noise cancellation, adaptive filters let you to remove noise from the signal in real time.





## ASSESSMENT



1. An adaptive filter is defined by four aspects. They are -----, -----, ----- and -----
2. The error signal  $e(k)$  is the difference between ----- and -----
3. An adaptive equalizer is an equalizer that automatically adapts to time-varying properties of the communication channel is called -----
4. Other applications of adaptive filters include ----- and -----
5. Prediction indicates -----
6. Define Noise Cancellation.



# THANK YOU