



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMB302 - BIOMEDICAL SIGNAL PROCESSING

III YEAR/ V SEMESTER

Unit V: DATA REDUCTION TECHNIQUES



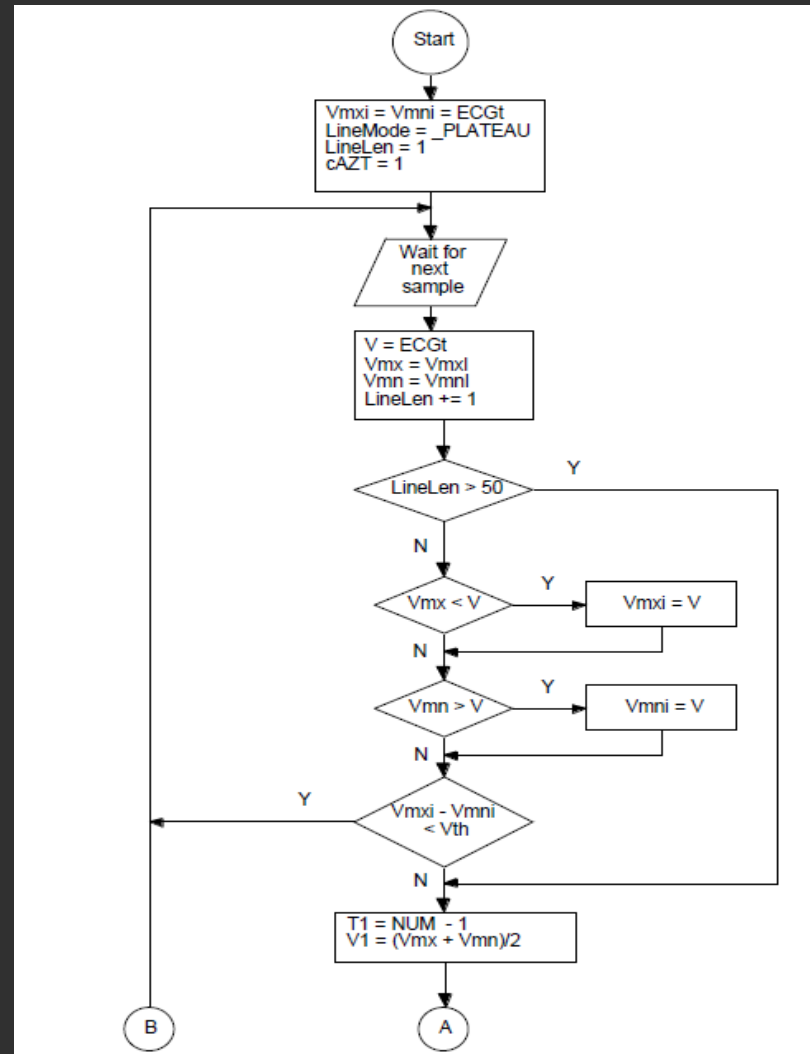
- Turning point algorithm
- **AZTEC algorithm**
- CORTES algorithm
- Fan algorithm
- Huffman algorithm

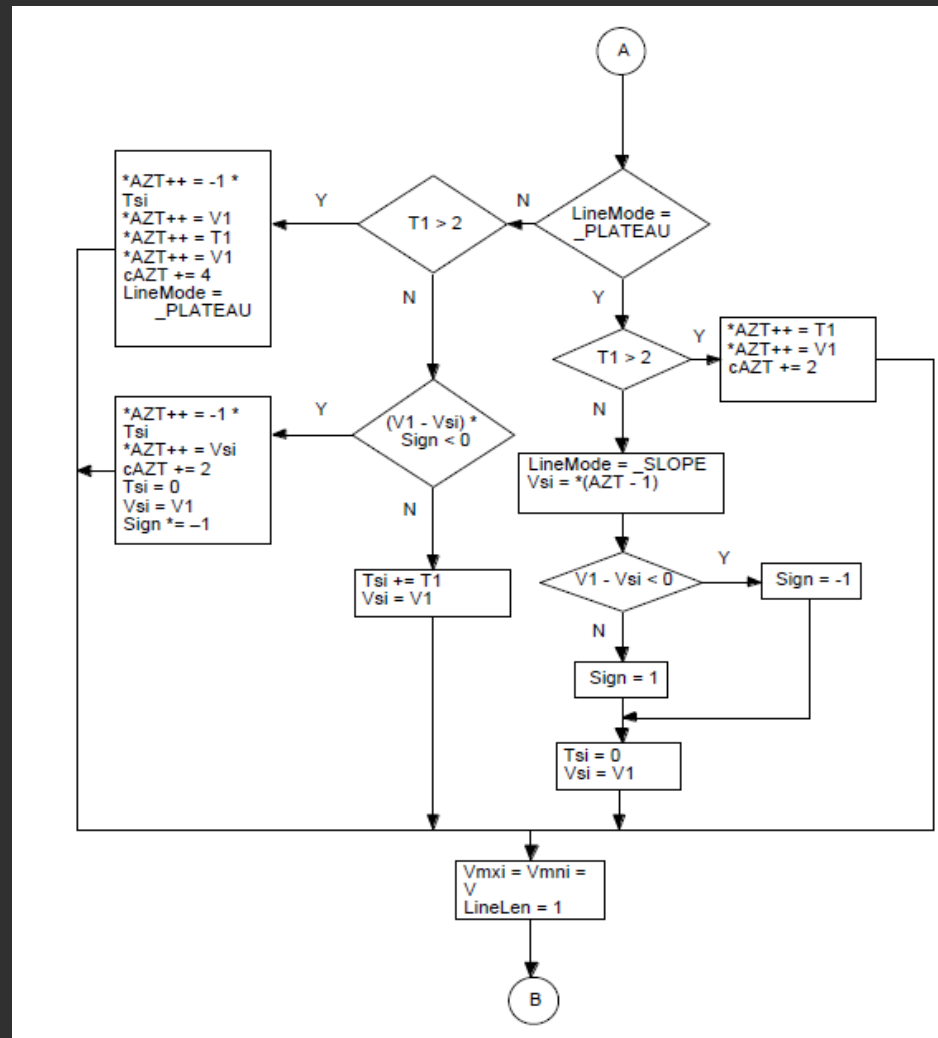


AZTEC algorithm



- Originally developed to preprocess ECGs for rhythm analysis, the AZTEC (Amplitude Zone Time Epoch Coding) data reduction algorithm decomposes raw ECG sample points into plateaus and slopes,
- It provides a sequence of line segments that form a piecewise-linear approximation to the ECG.
- The algorithm consists of two parts—line detection and line processing.
- Figure 1 shows the line detection operation which makes use of zero-order interpolation (ZOI) to produce horizontal lines.
- Two variables V_{mx} and V_{mn} always reflect the highest and lowest elevations of the current line.
- Variable *LineLen* keeps track of the number of samples examined.
- We store a plateau if either the difference between V_{mxi} and V_{mni} is greater than a predetermined threshold V_{th} or if *LineLen* is greater than 50.
- The stored values are the length ($LineLen - 1$) and the average amplitude of the plateau $(V_{mx} + V_{mn})/2$.







- When we reenter line processing with *LineMode* equal to `_SLOPE`, we either save or update the slope.
- The slope is saved either when a plateau of more than three samples can be formed or when a change in direction is detected.
- If we detect a new plateau of more than three samples, we store the current slope and the new plateau.
- For the slope, the stored values are its length Tsi and its final elevation $V1$.
- Note that Tsi is multiplied by -1 to differentiate a slope from a plateau (i.e., the minus sign serves as a flag to indicate a slope).
- We also store the length and the amplitude of the new plateau, then reset all parameters and return to plateau production.
- If a change in direction is detected in the slope, we first save the parameters for the current slope and then reset $sign$, Vsi , Tsi , $Vmxi$, and $Vmni$ to produce a new AZTEC slope.
- Now the algorithm returns to line detection but remains in slope production mode.
- When there is no new plateau or change of direction, we simply update the slope's parameters, Tsi and Vsi , and return to line detection with *LineMode* remaining set to `_SLOPE`.
- AZTEC does not produce a constant data reduction ratio.
- The ratio is frequently as great as 10 or more, depending on the nature of the signal and the value of the empirically determined threshold.



Data reconstruction



- The data array produced by the AZTEC algorithm is an alternating sequence of durations and amplitudes. A sample AZTEC-encoded data array is
- $\{18, 77, 4, 101, -5, -232, -4, 141, 21, 141\}$
- We reconstruct the AZTEC data by expanding the plateaus and slopes into discrete data points.
- For this particular example, the first two points represent a line 18 sample periods long at an amplitude of 77.
- The second set of two points represents another line segment 4 samples long at an amplitude of 101.
- The first value in the third set of two points is negative. Since this represents the length of a line segment, and we know that length must be positive, we recognize that this minus sign is the flag indicating that this particular set of points represents a line segment with nonzero slope.
- This line is five samples long beginning at the end of the previous line segment (i.e., amplitude of 101) and ending at an amplitude of -235 .
- The next set of points is also a line with nonzero slope beginning at an amplitude of -235 and ending 4 sample periods later at an amplitude of 141.
- This reconstruction process produces an ECG signal with steplike quantization, which is not clinically acceptable.
- The AZTEC-encoded signal needs postprocessing with a curve smoothing algorithm or a low-pass filter to remove its jagged appearance and produce more acceptable output.



Thank You!