JSPM's

Rajarshi Shahu College of Engineering, Pune

Department of Electronics & Telecommunication Engineering

INNOVATIONS IN TEACHING AND LEARNING

Subject: Signals and systems **Class:** S.Y. BTech E&TC Div A

Topic: Autocorrelation

NAME OF THE ACTIVITY: Experiment Designed.

Experiment designed titled 'Find the pattern size of texture images from Brodatz texture album based on own published Research paper

I. Concept:

The experiment introduces students to the concept of autocorrelation as a mathematical tool used for detecting periodicity and repetitive patterns within signals or images. By applying autocorrelation on texture images from the Brodatz texture database, students learn how to determine pattern size, orientation, and structural regularity within textures. This concept forms a bridge between signals and systems theory and practical applications in image processing, helping students appreciate how signal analysis extends to two-dimensional spatial data.

II. Objective(Goal):

- To help students understand the principle of autocorrelation and its ability to reveal self similarity in signals and textures.
- To design and perform an experiment for pattern size detection using 2D autocorrelation on Brodatz texture images.
- To connect theoretical knowledge of correlation and periodicity with real world applications such as texture synthesis, pattern analysis, and quality improvement in image based systems.
- To demonstrate the integration of signal processing concepts with computer vision techniques inspired by faculty's published research.

III. Appropriateness (Relevance of Selected Method):

The selected experiment is highly relevant for the subject Signals and Systems. It applies the concept of autocorrelation, a key topic in the syllabus, to an innovative image processing context. The use of Brodatz texture images provides real, structured patterns, making the experiment both visual and analytical. The experiment's design is inspired by a research level application, allowing students to experience how classroom theories evolve into advanced scientific work. It encourages interdisciplinary learning, connecting signals, systems, and computer vision domains.

IV. Effective Presentation (Implementation Details):

The experiment was demonstrated in the laboratory using MATLAB for computational analysis. Students were introduced to the Brodatz texture album, and selected a set of texture images (e.g., D1, D4, D21, D35) with varying periodicities. The 2D autocorrelation function was computed for each texture image, and the autocorrelation plots were analyzed to determine pattern size and periodicity. The instructor explained the relationship between autocorrelation peaks and pattern repetition distance. Students were guided through visualization, measurement, and result.

Periodicity and pattern size detection for quality improvement of the patch-based structural texture synthesis

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Abstract: The texture is the surface property that contains the repetition of patterns. One iteration of a pattern is called the texel. The regularity in the texels and texel's placement defines the texture classification as regular/structural or non-regular/random texture. The pattern size as well as the periodicity of textures is derived from the Brodatz album. The correlation between two adjacent patches is calculated instead of the autocorrelation of the whole texture image. The patch size is varied each time. If patch size matches with pattern size or its multiples, the correlation value is at peak. Repeated occurrences of correlation peaks, variation in peak correlation values, and strength of peak correlation values decide the periodicity of texture. Out of 112 textures of Brodatz album, 60 textures have a periodicity of more than 60%. The synthesised structural texture's quality is much improved when patches of pattern size are used instead of using patches of random size. The structural similarity of synthesised texture is increased from 0.0947 to 0.4142.

V. Results (Impact):

a) Students successfully determined the pattern sizes of various Brodatz textures by analyzing autocorrelation maps.
b) The activity deepened understanding of correlation, convolution, and periodicity, reinforcing fundamental course concepts through visual experimentation.
c) Students gained insight into how theoretical signal processing methods apply to modern image analysis and synthesis.

d) Enhanced motivation and curiosity were observed, particularly regarding the use of autocorrelation in machine vision and texture analysis applications.
e) The experiment promoted research oriented learning, connecting undergraduate studies with published scientific work.

VI. Reproducibility and Reusability by Other Scholars for Further Development

Sr.No	Innovation Used by	Details of User	Purpose of Reproducibility and Reusability
1	Manisha Rajput	DYPCOE	Appriciated & mentioned the usability in the course-ss at other institute.

VII. PEER REVIEW AND CRITIQUE

Category: Internal/External/Interdepartmental
Score: (1:Least 2: Moderate 3:Highly)
Question 1. Is this Innovative Teaching and Learning Methodology useful during content delivery?

Question 2. Did this innovation increase student motivation or participation?

Question 3. Will it shows improvement in student learning?

Question 4. Suggestions for improvement in future iterations.

Category	Name of Peer	Organization	Q.1	Q.2	Q.3	Q. 4 Suggestion/Critique
Internal	SPV Mrs. S. P. Vibhute	RSCOE EnTC	3	3	2	The visualization of autocorrelation helped students grasp periodicity.
External	Dr. Kirti Chaudhari	AISSMS	2	3	2	commended the innovation approach of using a published paper as the base for undergraduate experimentation
Interdepartmental	Kirti Deshpande	IT Dept.	3	2	3	Appreciated the interdisciplinary nature of the experiment. Recommended further integration with computer vision labs and inclusion of feature based pattern recognition for extended application

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