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# Adaptive Supervision Online Learning for Vision Based Autonomous Systems

By

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# Supplementary files

## Channel geometry

The following videos illustrate channel vector curves of N channels. The constant dimension is projected away, leaving a curve in a (N-1)-dimensional space. The curve, together with the (N-1)-simplex rotates in this (N-1)-dimensional space and is orthogonally projected to a 2D space and drawn. Note that the curves are not changing shape, they are only rotating in high dimensional spaces.
Four channels, 3D space
Five channels, 4D space
Seven channels, 6D space

The following videos illustrate the cone (in 3D, and the partially cone-like shape in higher dimensional cases) generated by scaled channel vectors of N channels. The shape is orthogonally projected to a 2D space and drawn. Note that the surfaces are not changing shape, they are only rotating in high dimensional spaces.
Three channels, 3D space
Four channels, 4D space
Seven channels, 7D space

## Hebbian Associative Learning

This video illustrates prediction using channel associative learning. During the video, the input value sweeps from 0 to 2 and back to zero. The encoded input value is displayed as scaled basis functions at the bottom of the figure. The elements of the ten by ten linkage matrix C are displayed in the right figure as an image, however since the edge channels have centers outside the representable interval, only the central eight by eight part of C is visible. The left figure shows the corresponding represented joint distribution. The channel encoded output is illustrated as scaled basis functions to the left. In the left figure, the sum of the scaled basis functions is drawn with a dashed line.
Associative learning illustration

## Non-linear Channel Layouts

The following videos demonstrate logarithmic and log-polar channel arrangements.

*Time-logarithmic Channels*

Each pixel in one of the PETS-sequences is channel encoded using regularly spaced channels along the intensity axis and logarithmic channel placement along the time dimension. All time values are set to one when encoding. Before encoding and adding a new frame, the time-intensity representation of each pixel is time-shifted using an approximation of the shifting operator which is linear in the channel coefficients. The represented information in five marked pixels is shown as plots where time is along the horizontal axis, with present time to the left, and intensity along the vertical axis, with white at the bottom and black at the top.
Decoding of five pixels in a sequence

## Log-polar Channel Layout

In the following sequences, each frame is encoded and decoded using spatial channels on a log-polar grid and regularly spaced channels along the intensity. Spatial resolution is thus lower close to the outer edge of the circle. However, intensity resolution is uniform across the image and thus edges of large areas with similar intensity is preserved.
Sequence with translating cameraman image
Video from UAV and, the original video from the UAV

## Autonomous Road Following Application

The first video demonstrates the use case of online learning autonomous road following. The second video shows the capabilities of the demonstrator system.
Use case demo
Demonstrator system