

Performance analysis of ASR system in
hybrid DNN-HMM framework using a PWL
euclidean activation function

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Frontiers of Computer Science, DOI: [10.1007/s11704-020-9419-z](https://doi.org/10.1007/s11704-020-9419-z)

Problems & Ideas

- Problems

- Hybrid ASR system suffers from vanishing gradient problem while training with Deep Neural Networks (DNN).
- Differential capability of the activation function affects DNN when trained with gradient based optimization methods.

- Ideas

- Euclidean norm activation function is proposed for modeling non-linearity of DNN which satisfies both properties of activation function viz. non-linearity and differentiability.
- The shape of the euclidean norm is learned during training as opposed to fixed activation function such as tanh, sigmoid.
- Creates a smooth, continuous quadratic expression without any sharp transition points compared to maxout units.

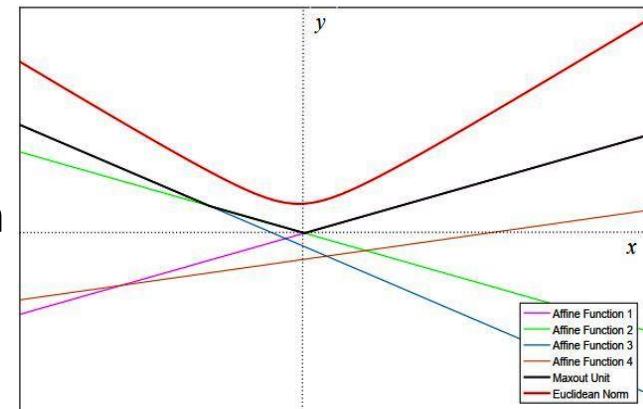


Figure: 2-D view of euclidean norm and maxout unit for four different affine functions illustrating point of discontinuity

Main Contributions

- Euclidean norm can approximate any arbitrary complex convex relationship.
- The graph of euclidean can be approximated by pieces of linear segments thereby shown to belong to Piecewise Linear (PWL) family.
- Better performance of ASR system in comparison with other conventional activation functions.

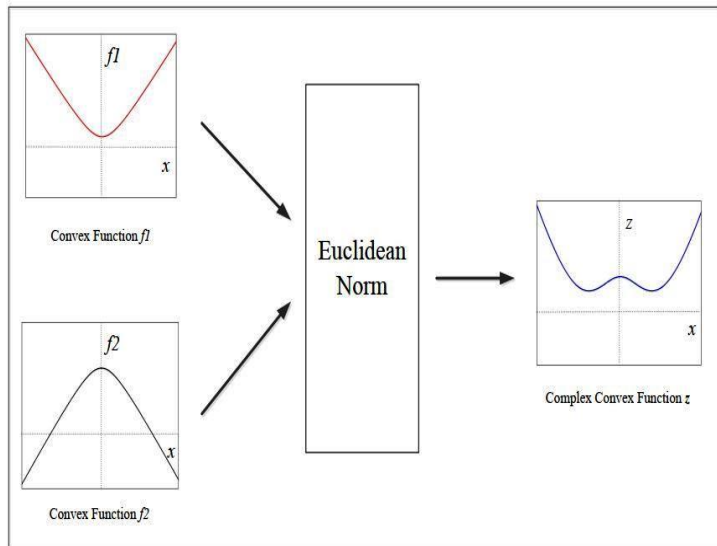


Figure: Complex functions approximated by euclidean norm activation functions

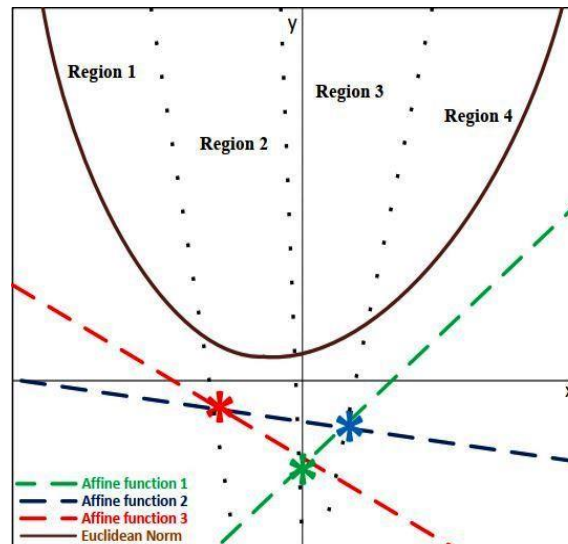


Figure: Pictorial view on the linear separability of euclidean norm

Activation Function	PER
Euclidean Norm	19.3
Maxout unit	19.6
ReLU	19.5
Tanh	20.3
Sigmoid	21.8

Figure: Comparison with different state of art activation functions