# Masking-like Non-Linearities from Non-Linear PCA

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Different approaches have been proposed to derive the visual gain control non-linearities looking for further component independence beyond the first linear ICA stage [1,2]. Parametric methods [1] are somehow biased because they already start from intrinsically non-linear functional forms such as divisive normalization. Non-parametric methods (e.g. using non-linear ICA [2]) give rise to stronger results since no functional form is assumed, so the response behavior strictly emerge from the PDF. However, the computational complexity of the non-parametric methods prevents their use in large-scale numerical experiments. Specifically, even though general masking trends were reproduced using non-linear ICA [2], the technique failed to reproduce some relevant details of cross-masking as for instance the relative interaction between neighboring frequency and/or orientation channels. This may be due to the low dimensionality of the considered samples (low frequency resolution) or the small size of the training set. Definitely, more efficient techniques are needed for accurate and robust exploration of these effects.

In this work we present an alternative differential technique for non-linear independent components computation: the *local-to-global non-linear PCA*, that allows more exhaustive experiments. The new results confirm the previously reported general masking trends [2], but, in addition, the relative interaction between different frequency or orientation channels is also reproduced. The responses below show that increasing the difference in frequency between stimulus and mask does reduce the masking effect. Therefore, the computational simplicity of the proposed technique makes it suitable to obtain new accurate predictions of contrast perception effects from natural image statistics.
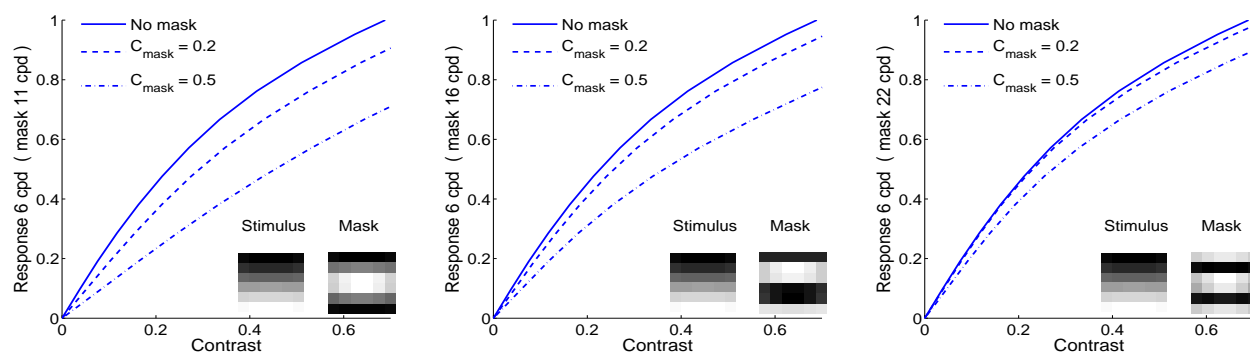
References

[1] Natural signal statistics and sensory gain control. O. Schwartz and E. Simoncelli, *Nature Neuroscience*, 4(8):819-825. 2001.

[2] V1 non-linear properties emerge from local-to-global non-linear ICA. J. Malo and J. Gutiérrez, *Network: Computation in Neural Systems*, 17(1):85-102. 2006.