

Contractivity of Competitive Neural Networks for Sparse Reconstruction



Veronica Centorrino

Ph.D. student

Scuola Superiore Meridionale, Naples, Italy

veronica.centorrino@unina.it



Alexander Davydov

UC, Santa Barbara



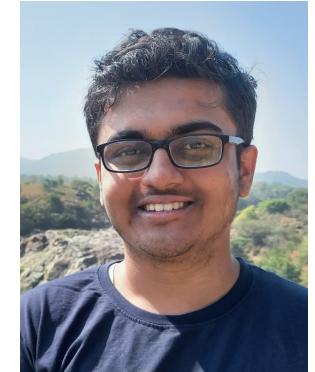
Prof. Francesco Bullo

University of California, Santa Barbara



Prof. Giovanni Russo

DIEM, University of Salerno, Italia

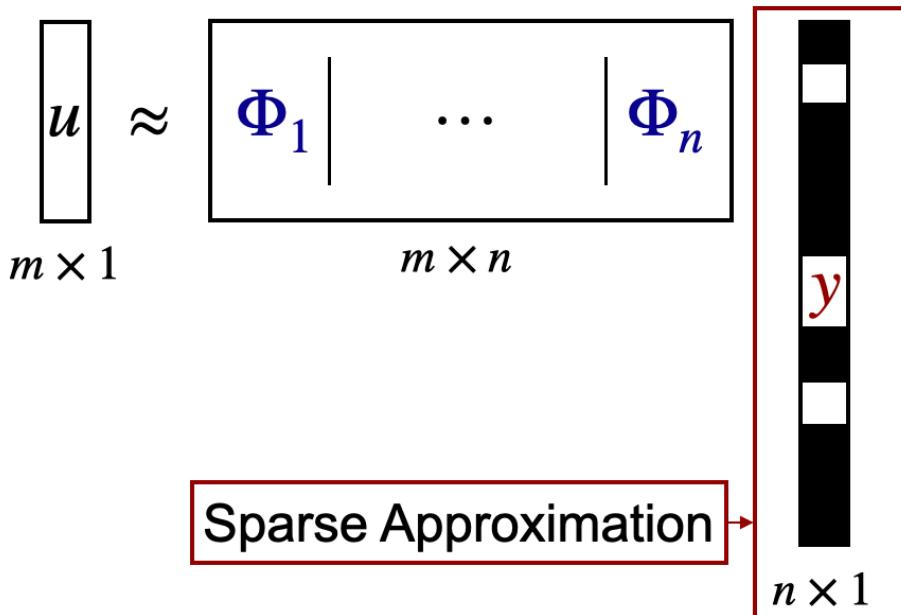


Anand Gokhale

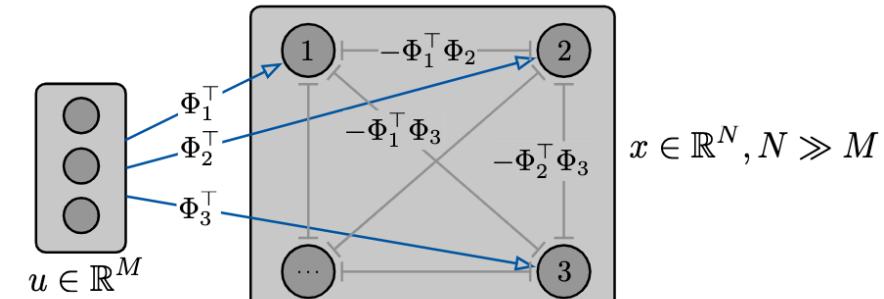
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Contractivity of Competitive Neural Networks for Sparse Reconstruction 2

$$\min_{y \in \mathbb{R}^n} \frac{1}{2} \|u - \Phi y\|_2^2 + \lambda C(y)$$



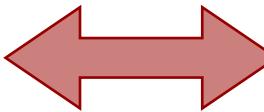
$$\dot{x} = -x + g_\lambda((I_N - \Phi^T \Phi)x + \Phi^T u)$$
$$y = x$$



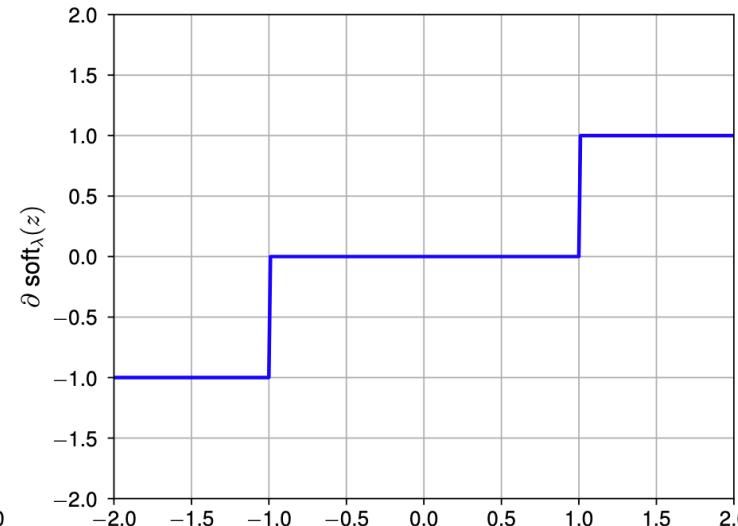
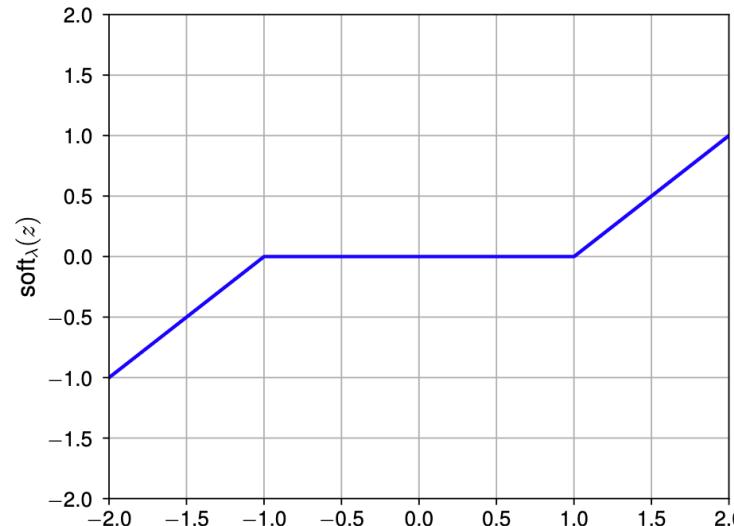
+

Contraction Theory

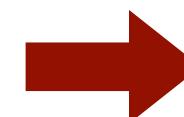
$$\min_{y \in \mathbb{R}^n} \frac{1}{2} \|u - \Phi y\|_2^2 + \lambda \|y\|_1$$



$$\dot{x} = -x + \text{soft}_\lambda((I_N - \Phi^T \Phi)x + \Phi^T u)$$



- Non-smooth activation functions
- Weight matrix is positive semidefinite



Contractivity analysis
of such systems.*

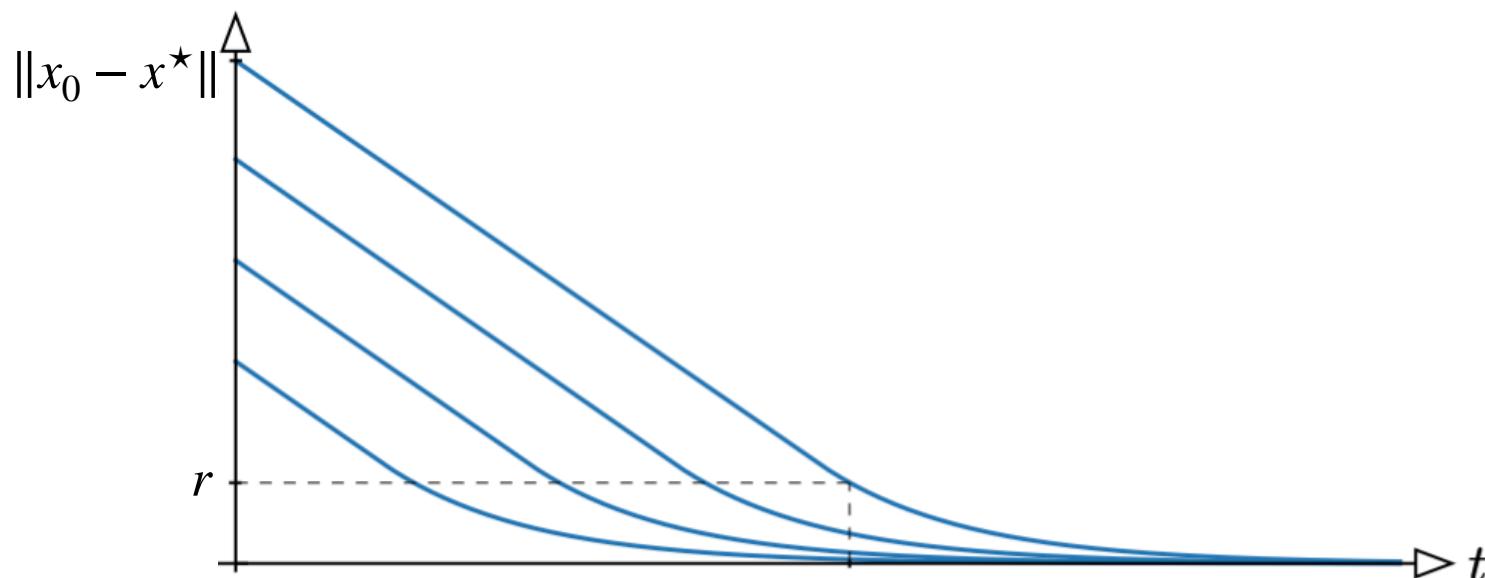
Given $\dot{x} = f(t, x)$ with an equilibrium point $x^* \in \mathbb{R}^n$ such that

(A1) f is globally weakly contracting,

(A2) f is locally strongly infinitesimally contracting in $B(x^*, r)$.

Then

$$\|x(t) - x^*\| \leq \|x_0 - x^*\| \cdot \text{lin-exp}(t)$$



Thank you for your attention!

veronica.centorrino@unina.it