Correction to: “SPOCU”: scaled polynomial constant unit activation function

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Introduction

Here we provide Addendum on SPOCU fitting and Erratum to Article Title: “SPOCU”: scaled polynomial constant unit

The original article can be found online at <https://doi.org/10.1007/s00521-020-05182-1>.

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activation function. <https://doi.org/10.1007/s00521-020-05182-1>.

Following the publication of our article [1], we have become aware that the legends of Fig. 8b should read as follows: generator $h(\cdot)$ of the activation function S . Moreover, the following Fig. 1 provides the graph of activation function S ($c = \infty$).

The SPOCU activation function is given by

$$s(x) = \alpha h\left(\frac{x}{\gamma} + \beta\right) - \alpha h(\beta) \quad (1)$$

where $\beta \in (0,1)$, $\alpha, \gamma > 0$ and

$$h(x) = \begin{cases} r(c), & x \geq c, \\ r(x), & x \in [0, c), \\ 0, & x < 0, \end{cases} \quad (2)$$

with $r(x) = x^3(x^5 - 2x^4 + 2)$ and $1 \leq c < \infty$ (we admit c goes to infinity with $r(c) \rightarrow \infty$).

Shortly after publication of our article [1], we have received questions from the community how to implement SPOCU, since it is not involved in current software packages, e.g. in Matlab or Python (Keras). Here we provide a short idea how to select parameters α, β, γ or c .

Parametric space for parameters of SPOCU is $(\alpha, \beta, \gamma, c) \in (0, \infty) \times (0,1) \times (0, \infty) \times (1, \infty] = P$. For proper choice of the parameters, it is sufficient they belong to P and they can satisfy several conditions. One set of conditions has been outlined in [1], which gives¹

$$Ef[s(z)] =: Mean(\alpha, \beta, c, \gamma) = 0 \quad (3)$$

$$Ef[s^2(z)] =: Var(\alpha, \beta, c, \gamma) = 1 \quad (4)$$

$$||J(\alpha, \beta, c, \gamma)|| < 1 \quad (5)$$

hold. Here $f(z)$ is the pdf of underlying distribution, J is the Jacobi matrix w.r.t to mean and variance parameters and $||\cdot||$ is the appropriate matrix norm, e.g. L_1 or L_2 , as considered in the application.

¹ Standard normality implies pdf of the form $f(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}$.

Fig. 1 Activation function S

However, other sets of conditions can be more attractive for the reader, all depends on the aims and type of network.

E.g. one can, similarly as in 5.1. of [1] fix $c = \gamma = 1$. And, to compute α , β one can consider Pareto density $g(x) = a(x+1)^{-a-1}$, $x > 0$, $a > 1$ to satisfy for some $a > 1$

$$\mathbb{E}_g[s(x)] = \frac{1}{a-1} \quad (6)$$

with additional condition $s'(0) = 1$, which is $2(\beta^2\beta^5 - \beta^4 + 3) = \gamma$. Thus, for Pareto tail parameter $a = 4$ we received in Maple software $\alpha = 0.8874425243$ and $\beta = 0.4495811364$.

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Reference

1. Kiselić J, Lu Y, Švihra J, Szépe P, Stehlík M (2020) “SPOCU”: scaled polynomial constant unit activation function. Neural Comput Appl. <https://doi.org/10.1007/s00521-020-05182-1>

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