Benchmark problems for curve fitting with soft computing methods.

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Source of benchmark functions:

Trejo-Caballero, G., Rostro-Gonzalez, H., Garcia-Capulin, C. H., Ibarra-Manzano, O. G., Avina-Cervantes, J. G., & Torres-Huitzil, C. (2015). Automatic curve fitting based on radial basis functions and a hierarchical genetic algorithm. *Mathematical Problems in Engineering*, *2015*.

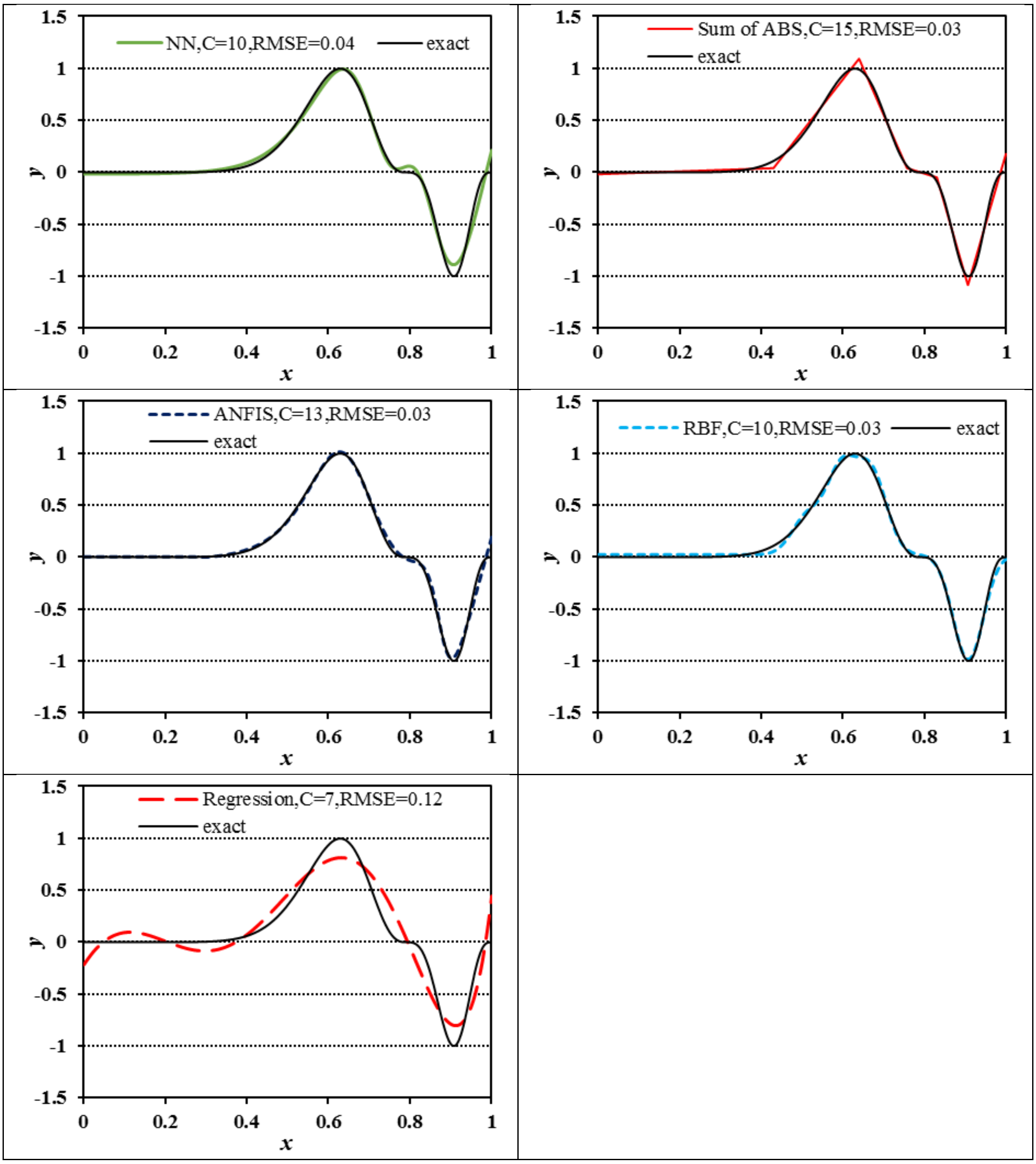
Summary

Function f(x)=(sin(2*π*x^3))^3 for 0≤x≤1 is used to benchmark the following methods: ANN, ANFIS, RBF NN, Regression, and sum of ABS functions

Function 1

$$f_1(x) = \sin^3(2\pi x^3), 0 \le x \le 1$$

Results



In These figures, C = complexity parameter = number of model coefficients. Curve fitting was done using N=2001 points (dx=0.005). The functions used are summarized below:

ANN: $y = a_0 + \sum_{i=1}^{N} a_i \tanh\left(a_{i0} + a_{i1}x\right)$

a0=0.887621	N=3	
a1=-30.6171	a10=-8.3362	a11=10.00038
a2=-106.861	a20=6.457407	a21=-8.23377
a3=-75.3389	a30=-6.68999	a22=8.784619

Sum of abs: $y = a_0 + \sum_{i=1}^{N} a_i \left|x - x_i\right|$

N	7	a0	-15.1763
x1	-0.00042	a1	15.31751
x2	0.430233	a2	2.440755
x3	0.640074	a3	-6.98449
x4	0.757591	a4	3.867542
x5	0.830855	a5	-6.20475
x6	0.906872	a6	13.58662
x7	1	a7	8.476821

ANFIS

$$w_1 = \exp\left(-\frac{(x-x_1)^2}{\sigma^2}\right), w_2 = \exp\left(-\frac{(x-x_2)^2}{\sigma^2}\right), w_3 = \exp\left(-\frac{(x-x_3)^2}{\sigma^2}\right)$$

$$f_1 = a_{10} + a_{11}x + a_{12}x^2,\ f_2 = a_{20} + a_{21}x + a_{22}x^2,\ f_3 = a_{30} + a_{31}x + a_{32}x^2$$

$$y = \frac{w_1 f_1 + w_2 f_2 + w_3 f_3}{w_1 + w_2 + w_3}$$

sigma	x0	a0	a1	a2
σ=0.106112	x1=0.570741	a10=0.095649	a11=-0.86677	a12=1.68663
	x2=0.699491	a20=44.31489	a12=-111.467	a22=70.06595
	x3=1.047322	a30=-23.7182	a13=33.80494	a32=-9.89945

RBF $y = a_0 + \sum_{i=1}^{N} \exp\left(-\frac{(x-x_i)^2}{\sigma^2}\right)$, N=4

a_0	0.019731	σ	0.052387
a_1	0.358906	x_1	0.511221
a_2	0.8014	x_2	0.595444
a_3	0.760517	x_3	0.670027
a_4	-1.00736	x_4	0.906368

Regression

$y=a_0+a_1x+a_2x^2+a_3x^3+a_4x^4+a_5x^5+a_6x^6$

a0	-0.2177
a1	6.098263
a2	-32.181
a3	-0.25721
a4	269.289
a5	-469.599
a6	227.3128