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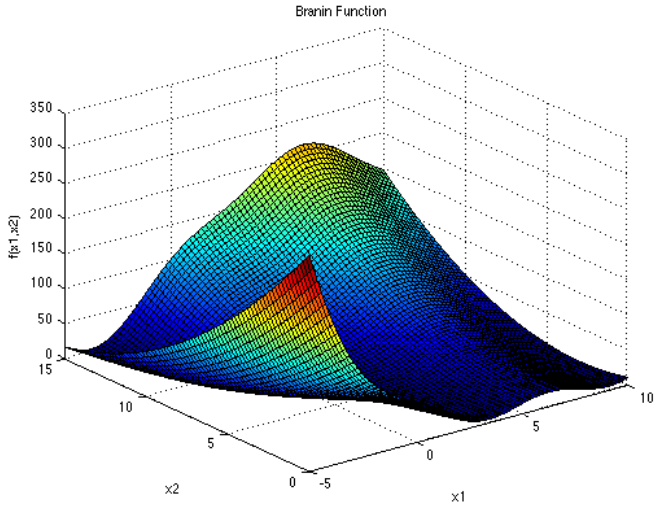
BRANIN FUNCTION



$$f(\mathbf{x}) = a(x_2 - bx_1^2 + cx_1 - r)^2 + s(1-t)\cos(x_1) + s$$

Description:

Dimensions: 2

The Branin, or Branin-Hoo, function has three global minima. The recommended values of a, b, c, r, s and t are: a = 1, b = $5.1/(4\pi^2)$, c = $5/\pi$, r = 6, s = 10 and t = $1/(8\pi)$.

Input Domain:

This function is usually evaluated on the square $x_1 \in$ [-5, 10], $x_2 \in$ [0, 15].

Global Minimum:

$$f(\mathbf{x}^*) = 0.397887, \text{ at } \mathbf{x}^* = (-\pi, 12.275), (\pi, 2.275) \text{ and } (9.42478, 2.475)$$

Modifications and Alternate Forms:

Picheny et al. (2012) use the following rescaled form of the Branin-Hoo function, on $[0, 1]^2$:

$$f(\mathbf{x}) = \frac{1}{51.95}\left[\left(\bar{x}_2 - \frac{5.1\bar{x}_1^2}{4\pi^2} + \frac{5\bar{x}_1}{\pi} - 6\right)^2 + \left(10 - \frac{10}{8\pi}\right)\cos(\bar{x}_1) - 44.81\right], \text{ where}$$

$$\bar{x}_1 = 15x_1 - 5, \ \bar{x}_2 = 15x_2$$

This rescaled form of the function has a mean of zero and a variance of one. The authors also add a small Gaussian error term to the output.

For the purpose of Kriging prediction, Forrester et al. (2008) use a modified form of the Branin-Hoo function, in which they add a term $5x_1$ to the response. As a result, there are two local minima and only one global minimum, making it more representative of engineering functions.

Code:

MATLAB Implementation

R Implementation

MATLAB Implementation, Rescaled

R Implementation, Rescaled

MATLAB Implementation, Modified

R Implementation, Modified

References:

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Molga, M., & Smutnicki, C. Test functions for optimization needs (2005). Retrieved June 2013, from http://www.zsd.ict.pwr.wroc.pl/files/docs/functions.pdf.

Picheny, V., Wagner, T., & Ginsbourger, D. (2012). A benchmark of kriging-based infill criteria for noisy optimization.

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