We consider the following stochastic expected value model,

$$\begin{cases} \min E\left[\sqrt{(x_1-\xi_1)^2+(x_2-\xi_2)^2+(x_3-\xi_3)^2}\right] \\ \text{subject to:} \\ \qquad x_1^2+x_2^2+x_3^2 \le 10 \end{cases}$$

where ξ_1 is a uniformly distributed variable $\mathcal{U}(1,2)$, ξ_2 is a normally distributed variable $\mathcal{N}(3,1)$, and ξ_3 is an exponentially distributed variable $\mathcal{EXP}(4)$.

In order to solve this model, we generate input-output data for the uncertain function

$$U : (x_1, x_2, x_3) \to E\left[\sqrt{(x_1-\xi_1)^2+(x_2-\xi_2)^2+(x_3-\xi_3)^2}\right]$$

by stochastic simulation. Then we train an NN (3 input neurons, 5 hidden neurons, 1 output neuron) to approximate the uncertain function U. After that, the trained NN is embedded into a GA to produce a hybrid intelligent algorithm.

A run of the hybrid intelligent algorithm (3000 cycles in simulation, 2000 data in NN, 300 generations in GA) shows that the optimal solution is

$$\boldsymbol{x}^* = (1.1035, 2.1693, 2.0191)$$

whose objective value is 3.56.