List of Variables

b_t	number of engineering control methods to reduce noise at machine *t*
cb_v	cost of installing barrier *v*
ch_l	cost of using hearing protection device *l*
chro_l	length of chromosome
C_j	length of time (hour) spent at worker location *j*
cross_no	number of selected chromosomes involved in the crossover
cross_pair	number of pairs of chromosomes involved in the crossover
cs_{tu}	cost of reducing noise at machine *t* using engineering control method *u*
da_{ik}	Euclidean distance between worker location *i* and alarm device *k*
dm_{ij}	Euclidean distance between worker location *i* and machine *j*
D_T	daily noise dose
d_{tj}	Euclidean distance between machine *t* and worker location *j*
EB	budget for engineering controls
EC	total cost of engineering controls
$eval(v_k)$	the evaluation function of string v_k
F	total worker-location changeover
f_j	number of worker-location changeovers at worker location *j*
$f_k(v_k)$	fitness function
Gen	*generation*
h	ceiling height (m)
HB	budget for HPDs
HC	total cost of HPDs used
I	sound intensity
I_{ab}	ambient sound intensity (W/m^2)
I_j	sound intensity (W/m^2) of machine *j*, at a distance of 1 m
$\bar{I}m_i$	total (ambient and machine) noise intensity (W/m^2) at worker location *i*
$\bar{I}a_i$	total alarm signal sound intensity (W/m^2) at worker location *i*
L	sound pressure level
L_{ab}	ambient noise level, dB*A*
L_{alarm}	signal sound level (dB*A*) of the alarm device, measured at 1 m
L_j	sound level generated by machine or alarm device *j* (measured at 1 m), dB*A*
l_j	daily noise load at worker location *j*
l_{max}	maximum daily noise load at any worker location
	location *i*, dB*A*
$\bar{L}a_i$	combined alarm signal sound level (dB*A*) at worker location *i*
$\bar{L}m_i$	combined noise level (dB*A*) at worker location *i*
$\bar{L}_i$	combined sound level (from all machines or all alarm devices) at worker location *i*, dB*A*
L_t'	noise level (dB*A*) measured at machine *t* (at 1-m distance) after noise reduction
M	number of available workers in the *new* workforce
m	number of workers in the current workforce

Max_gen	maximum generation
mut_no	number of mutated bits
n	number of worker locations
NRb_{jv}	amount of noise (dB*A*) reduced at worker location *j* after installing barrier *v*
NRh_l	amount of noise (dB*A*) reduced after wearing HPD type *l*
NRs_{tu}	amount of noise (dB*A*) reduced at machine *t* after applying engineering control method *u*
p	number of work periods per workday
P	sound power
P_{alarm}	sound power (W) of the alarm device
Pc	crossover probability
p_k	a penalty coefficient
Pm	mutation probability
$Popsize$	population size
$P_{\text{alarm}}^{\max}$	maximum allowable sound power (W) of the alarm device
q	number of machines (noise sources)
r	number of alarm devices needed for the considered facility
s	number of engineering control methods to block the noise transmission path
TB	total budget for the noise control program
v_k	binary string *k* in the population
W_i	8-hour TWA that worker *i* receives, dB*A*
w_j	noise load per work period at worker location *j*
x_{ijk}	1 if worker *i* is assigned to worker location *j* in work period *k*; 0 otherwise
yb_v	1 if noise reduction using barrier *v* is applied; 0 otherwise
yh_{jl}	1 if HPD *l* is used at worker location *j*; 0 otherwise
y_i	1 if worker *i* is assigned; 0 otherwise
ys_{tu}	1 if noise reduction at machine *t* using engineering control method *u* is applied; 0 otherwise
z	number of HPD types