

1/13

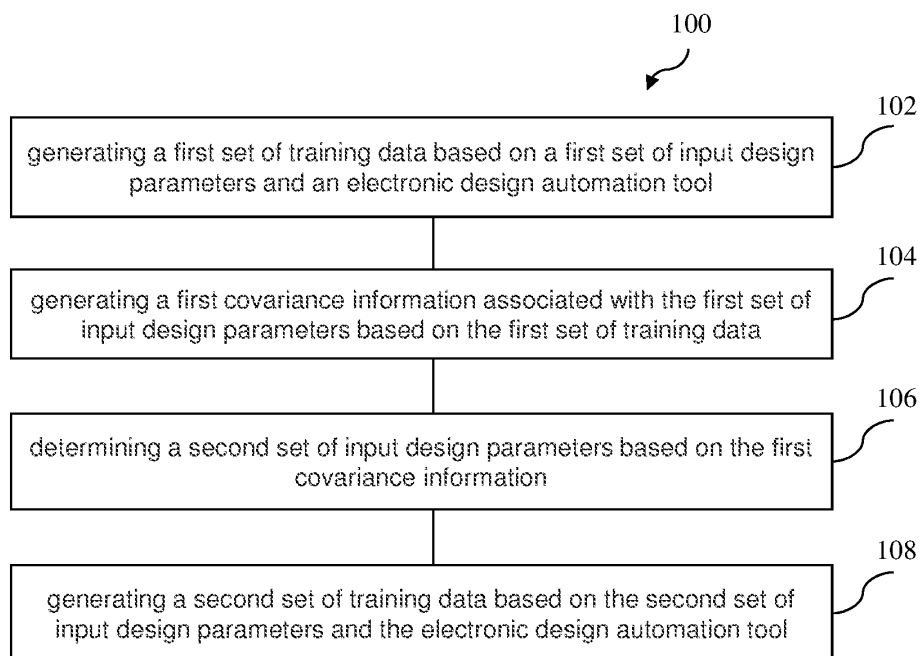


FIG. 1

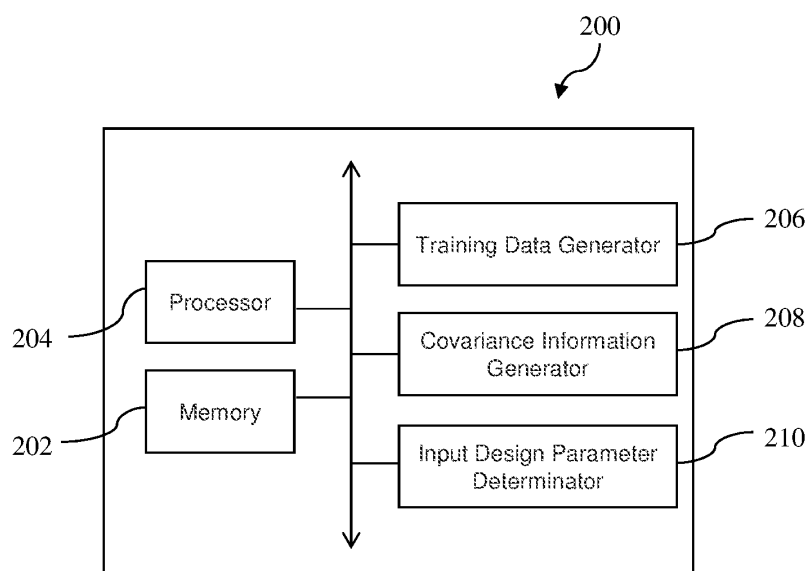


FIG. 2

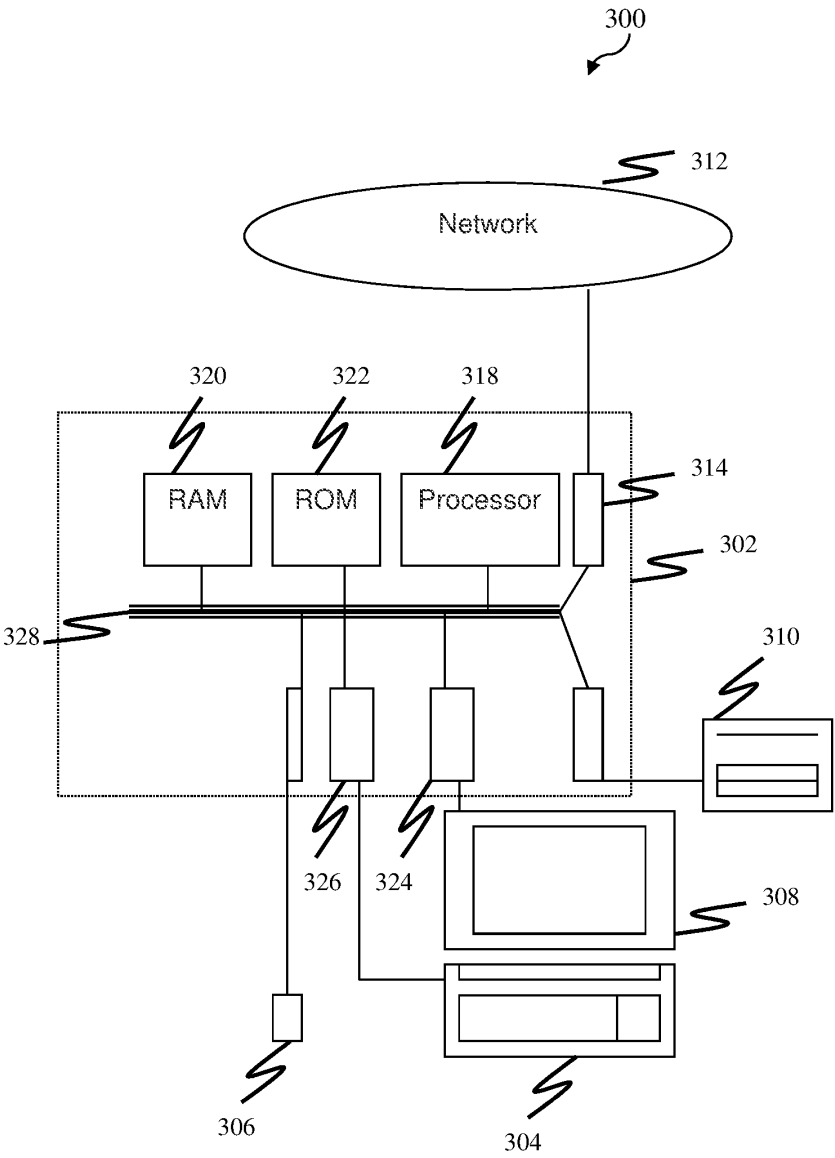


FIG. 3

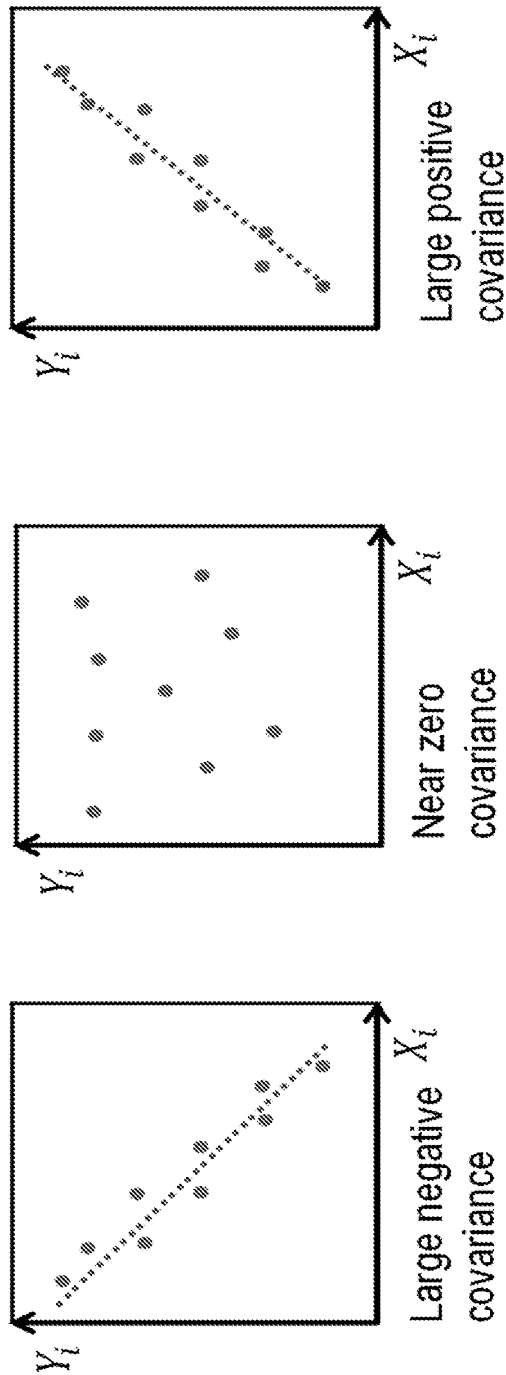


FIG. 4

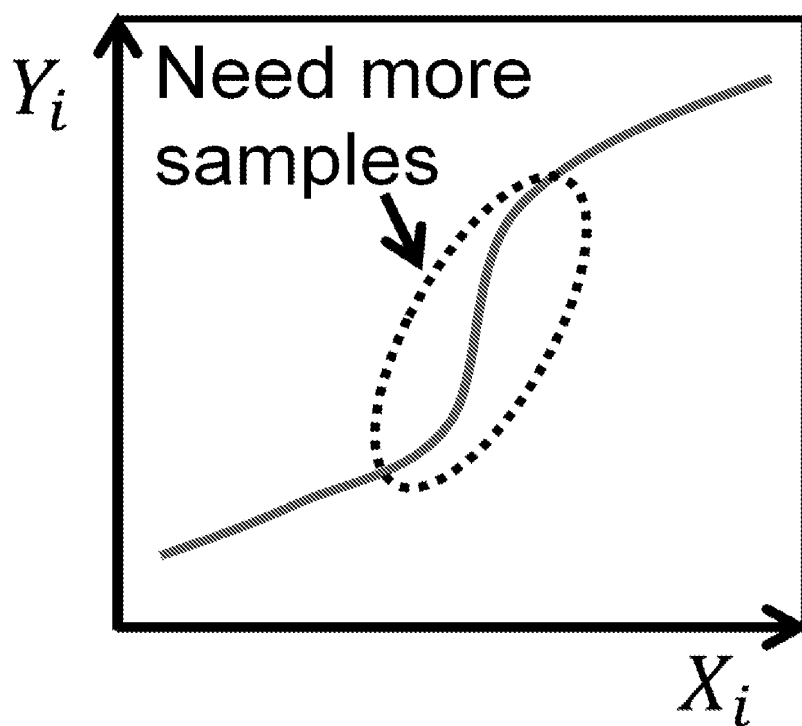


FIG. 5

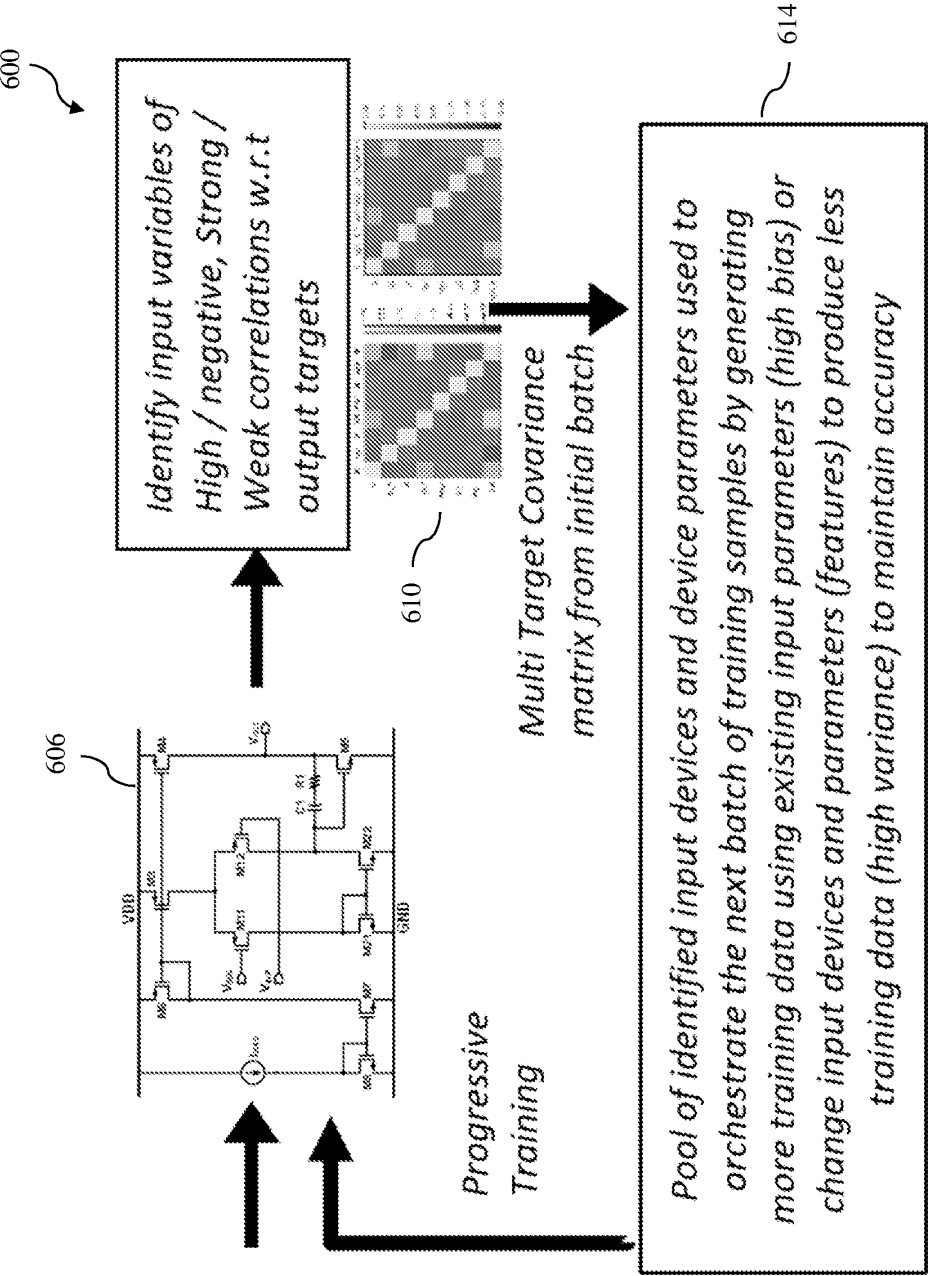


FIG. 6

6/13

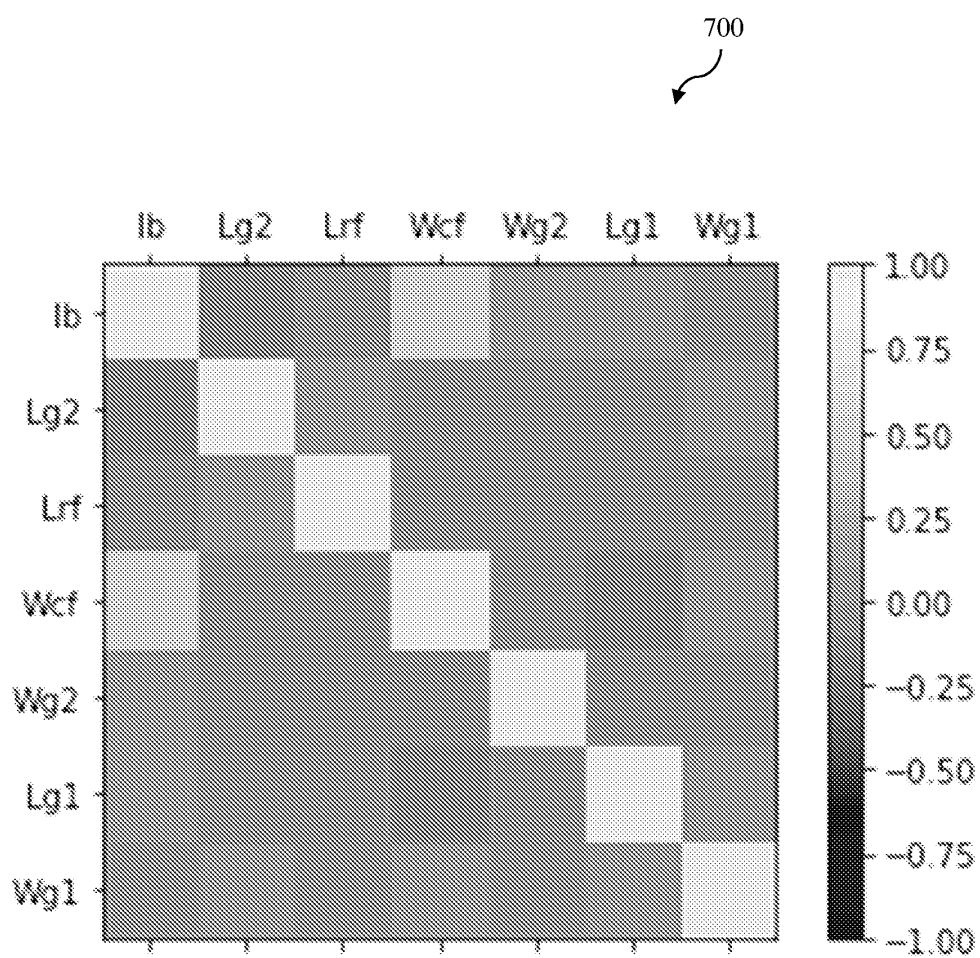
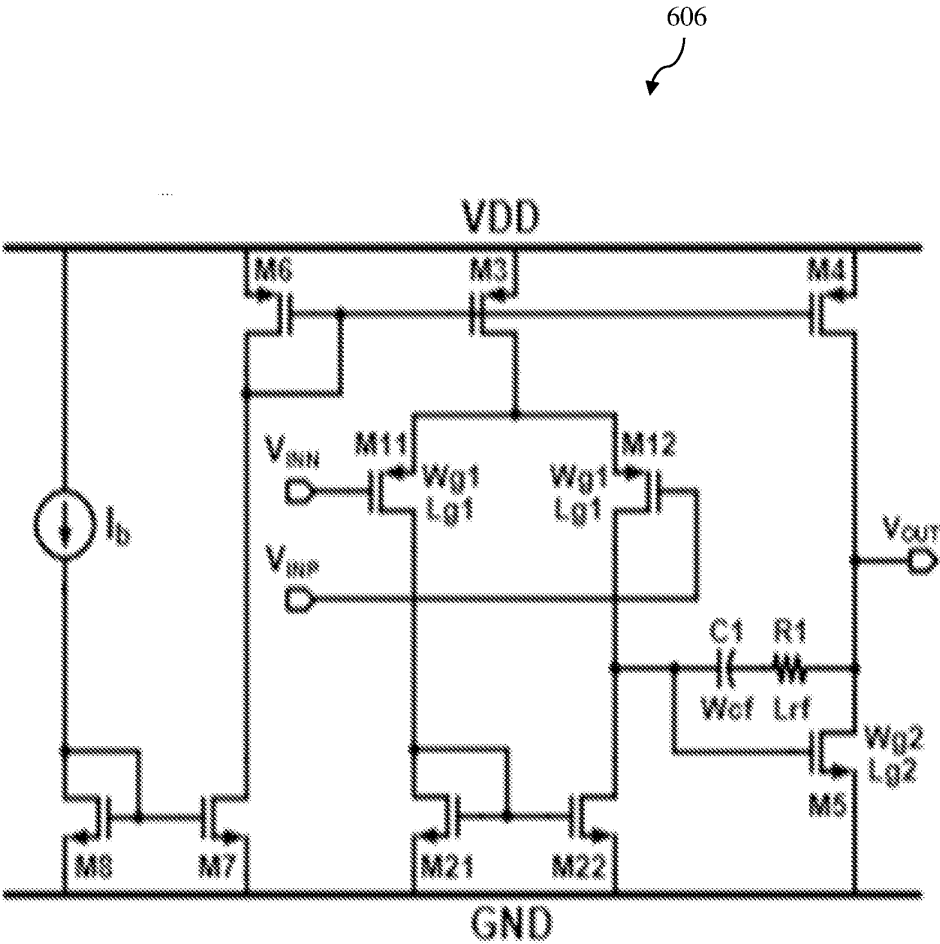


FIG. 7



: Schematic of a two-stage operational amplifier.

FIG. 8

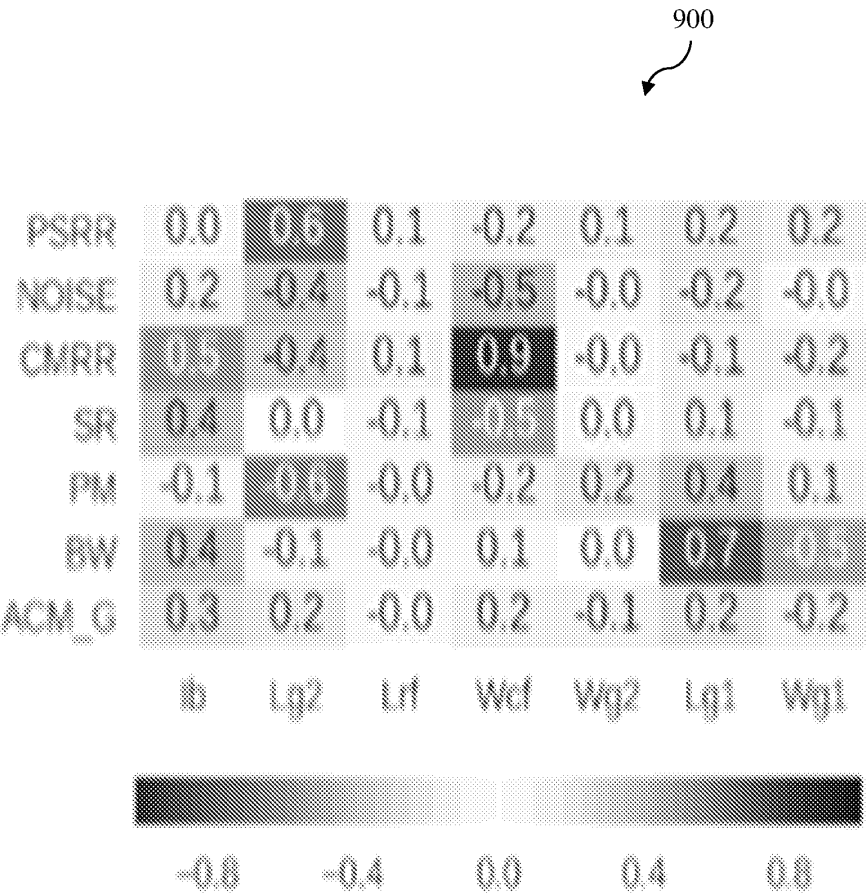


FIG. 9

9/13

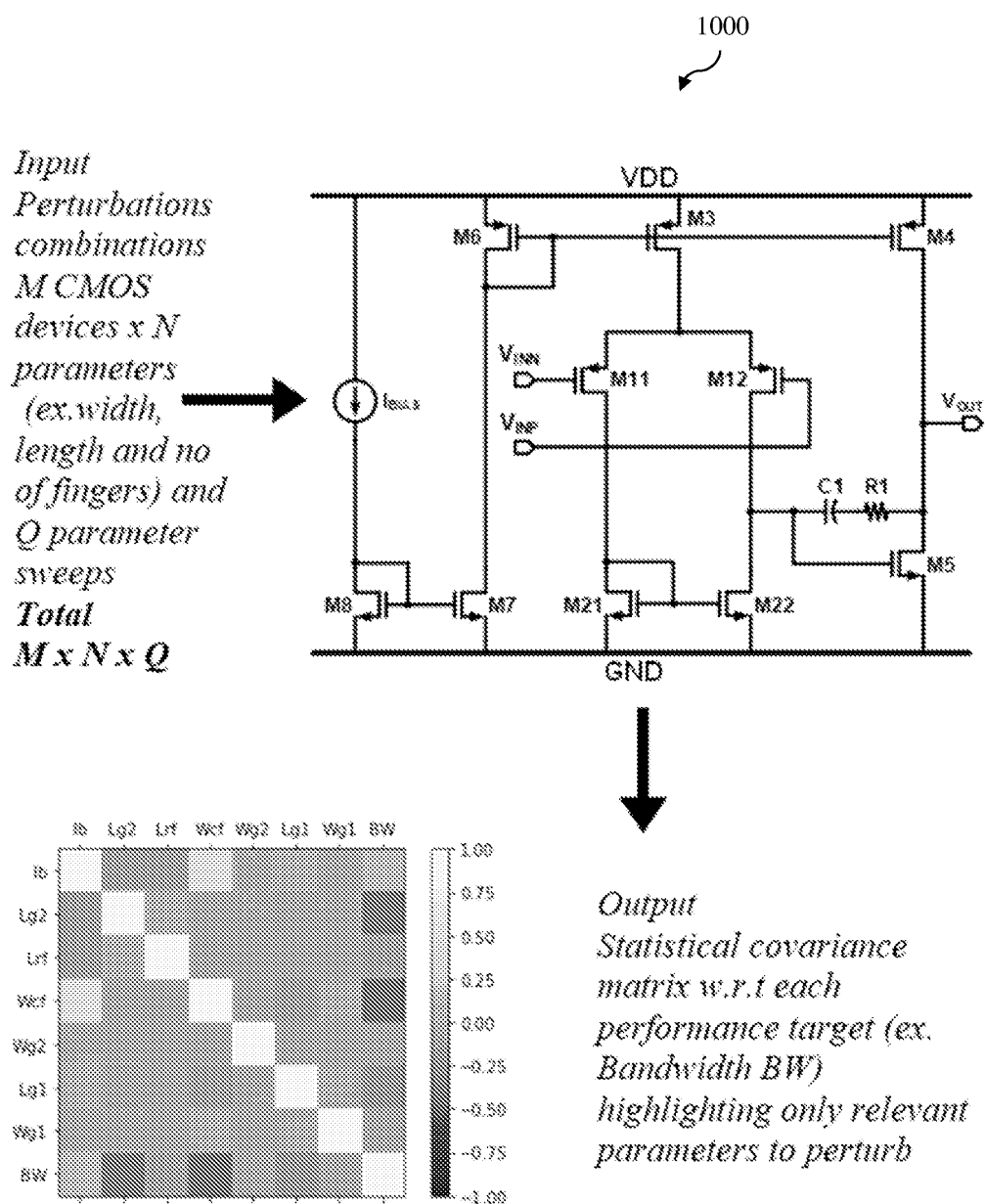


FIG. 10

10/13

Function: *ControlInputPerturbation(Circuit Netlist);*

Input: M, N, Q, DC ; // M (devices), N (device attributes), Q (parameter sweep range), Device design or technology constraints

Output: m, n, q ; // subset of M, N and Q

// Initial Sampling

1. Read circuit netlist, foundry models and test bench;
2. Read tech and design constraints on device parameters;
3. Parameterize circuit devices;
4. Generate random template T on M, N, Q ;
5. Run Simulation ; // EDA tool

// CM driven progressive sampling

6. Develop covariance matrix database; // (CMDB)
7. Develop Training and Testing error database; //(TTDB)
8. Sort CM, identify high / low covariance w.r.t outputs;
9. For each identified cm in CM database
 - // high variance
 - | 8.1 for all cm, where covariance is < 0.5 & TTDB > 0
 - | 8.1.1 pick another random input devices w.r.t #2
 - // high bias
 - | 8.2 for all cm, where covariance is > 0.5 & TTDB < 0
 - | 8.2.1 pick random parameter values w.r.t #2;
 - | 8.3 run simulation and label;
 - | 8.4 update CM database #6;

End

End

FIG. 11

11/13

Results

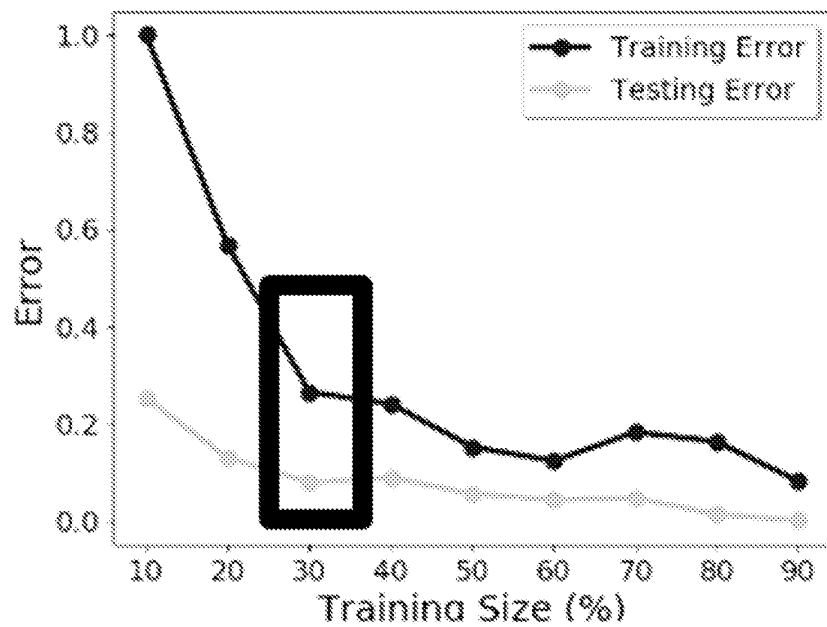


FIG. 12A

Results

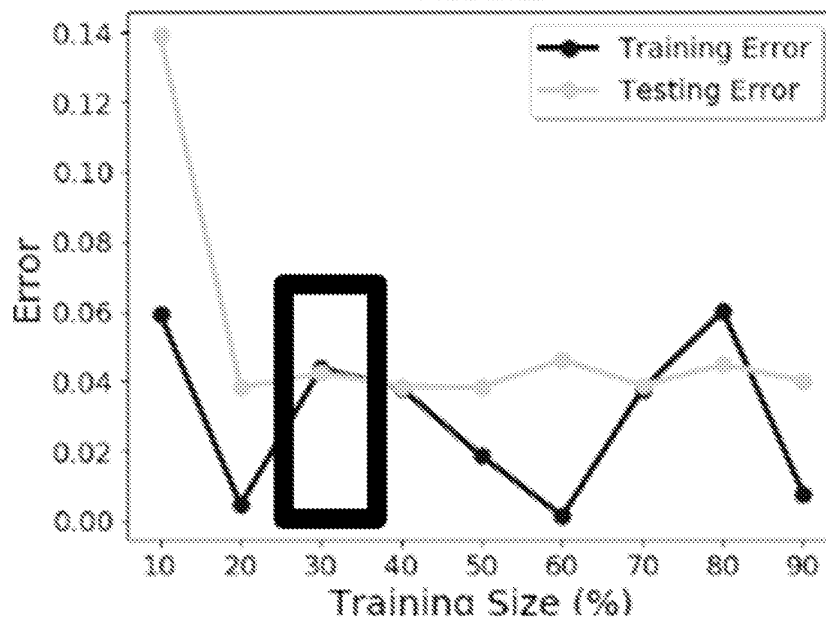


FIG. 12B

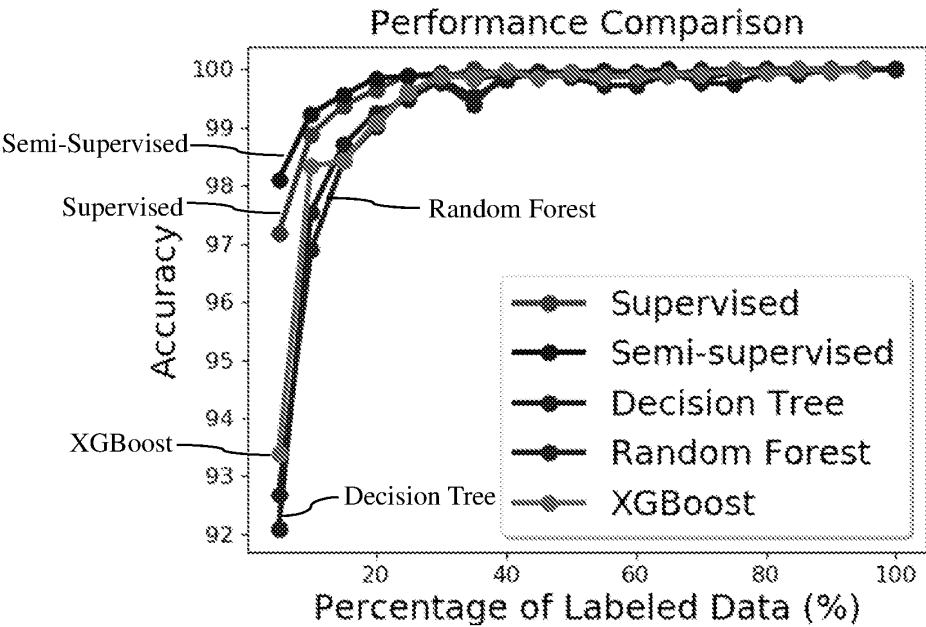


FIG. 13A

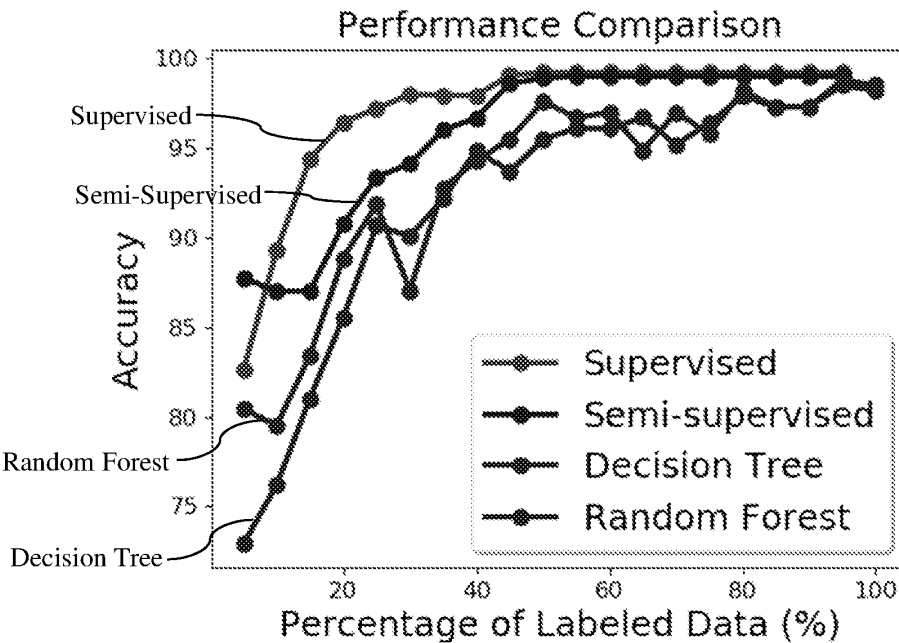


FIG. 13B

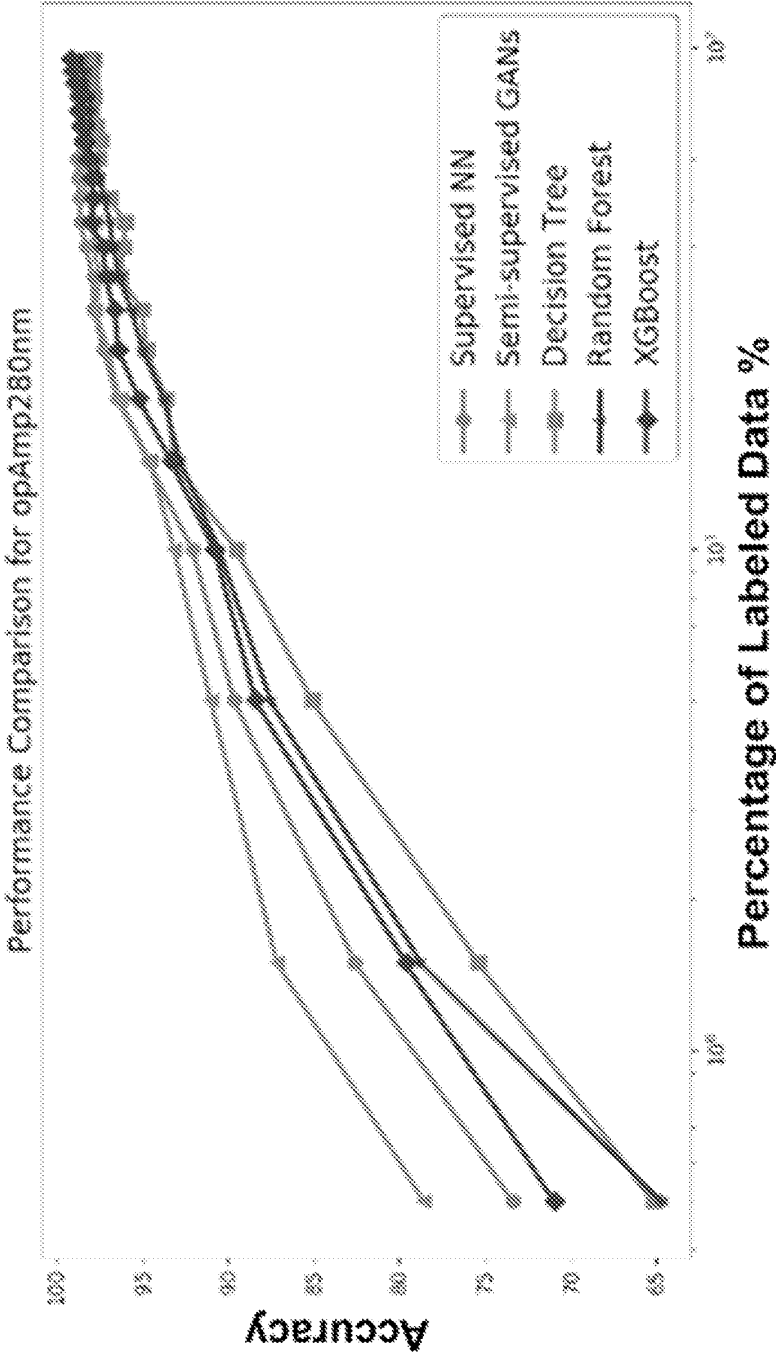


FIG. 14