

Ten Step Precision Machine Design Process

1. Identify need
 - a. Background study
2. Start FRDPARRC table
 - a. Identify dominant overall physics, references, risks
3. Create Solution Strategies
 - a. Stick Figures
 - b. FRDPARRC table for each strategy
 - c. Error Apportionment for different strategies
 - d. Model 1st order loads, stiffness requirements
 - e. Geometric error budgets for “top” strategies
4. Ruminare, play, evolve, pick “best” strategy
5. Create Concepts for best strategy
 - a. Sketches, coarse (realistic proportions) solid model
 - b. Error Apportionment
 - c. Model 1st order loads, stiffness requirements
 - d. FRDPARRC table for each concept
 - e. Sketch models
 - f. Bench level tests
 - g. Safety review
 - h. Ergonomics and manufacturing review
6. Preliminary Error Budgets for top concepts
 - a. Study options for primary structure, bearings, actuators, sensors
 - i. Model preload method, stiffness, life, accuracy
 - ii. Parasitic & environmental errors
7. Select “best” concept for detailing
 - a. Final component selection, modeling, and detailing for prototype axis (Most Critical Module)
 - b. Update error budget
 - c. Update FRDPARRC
 - d. Solid model parts, assembly, and make drawings
8. Build and test prototype axis (Most Critical Module)
 - a. Computer control
 - b. Measure performance and compare to predicted performance
 - c. Load capacity, stiffness, accuracy, repeatability, resolution)
9. Complete engineering analysis and detail of entire machine
 - a. Final component selection, modeling, and detailing for prototype axis (Most Critical Module)
 - b. Update error budget
 - c. Update FRDPARRC
10. Build and test
 - a. Computer control of axes
 - b. Measure performance and compare to predicted performance
 - c. Load capacity, stiffness, accuracy, repeatability, resolution)
11. Document

Note—there should be a continual assessment of Risks and Countermeasures!