4.2 Natural Frequency Evaluation of a Synchronous Cylinder System

The natural frequency is an important parameter in precise control systems. In many cases the natural frequency can be calculated by using simplication and linearigation techniques. For example, consider the double acting control system shown in the schematic in Fig. 4.2a which can be simplified as shown in Fig. 4.2b. The natural frequency of the simplified system can be calculated by the following equation:

$$\omega_o = \sqrt{\frac{4 \cdot \beta \cdot A}{M \cdot S}}$$

where:

β = Fluid Bulk Modulus
A = Piston Area Receiving Pressure
M = Mass
S = Stroke

Assume the following values:

β = 150,000 psi
A = 2.011 in^2
M = 0.31 LBf sec/in^2
S = 20 inches

The natural frequency of the simplified system will be found to be 441 rad/sec.

HyPneu is capable of using the actual system (not simplified) as shown in Fig. 4.2a. the results obtained using the frequency analysis of HyPneu is shown by the curves.

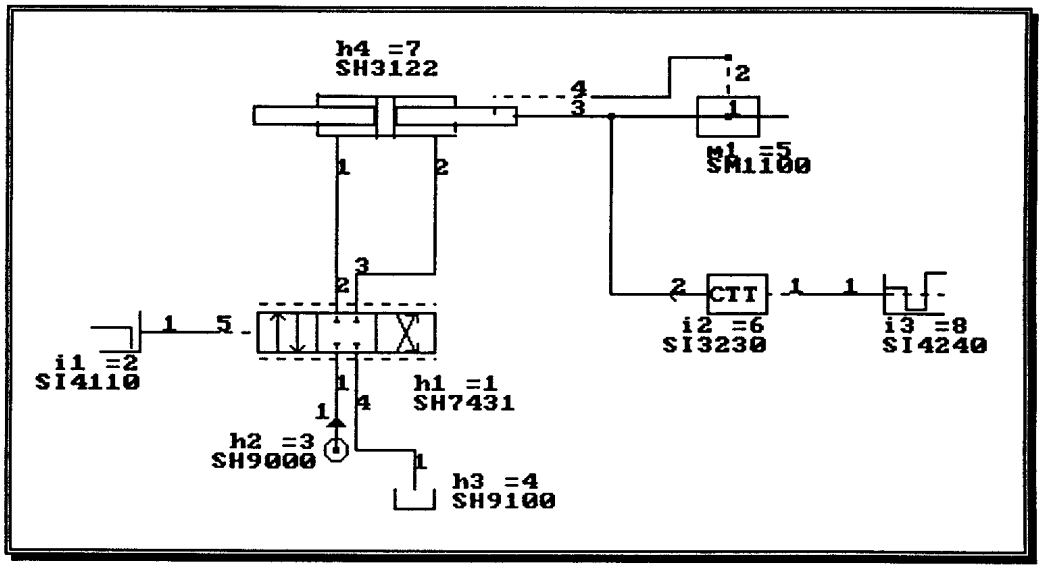

Figure 4.2a. Double Acting Control System Schematic.

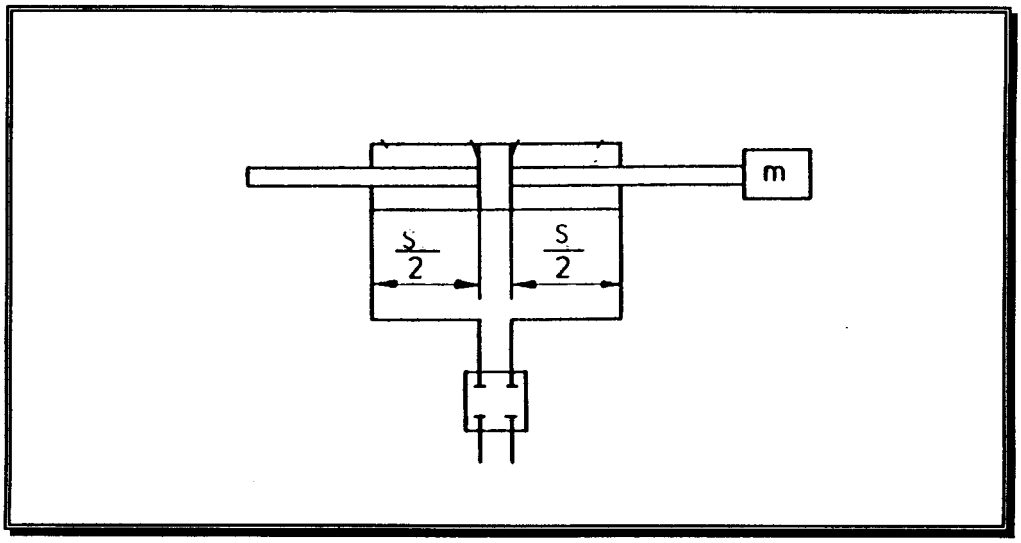

Figure 4.2a. Simplified Double Acting Control System Schematic.

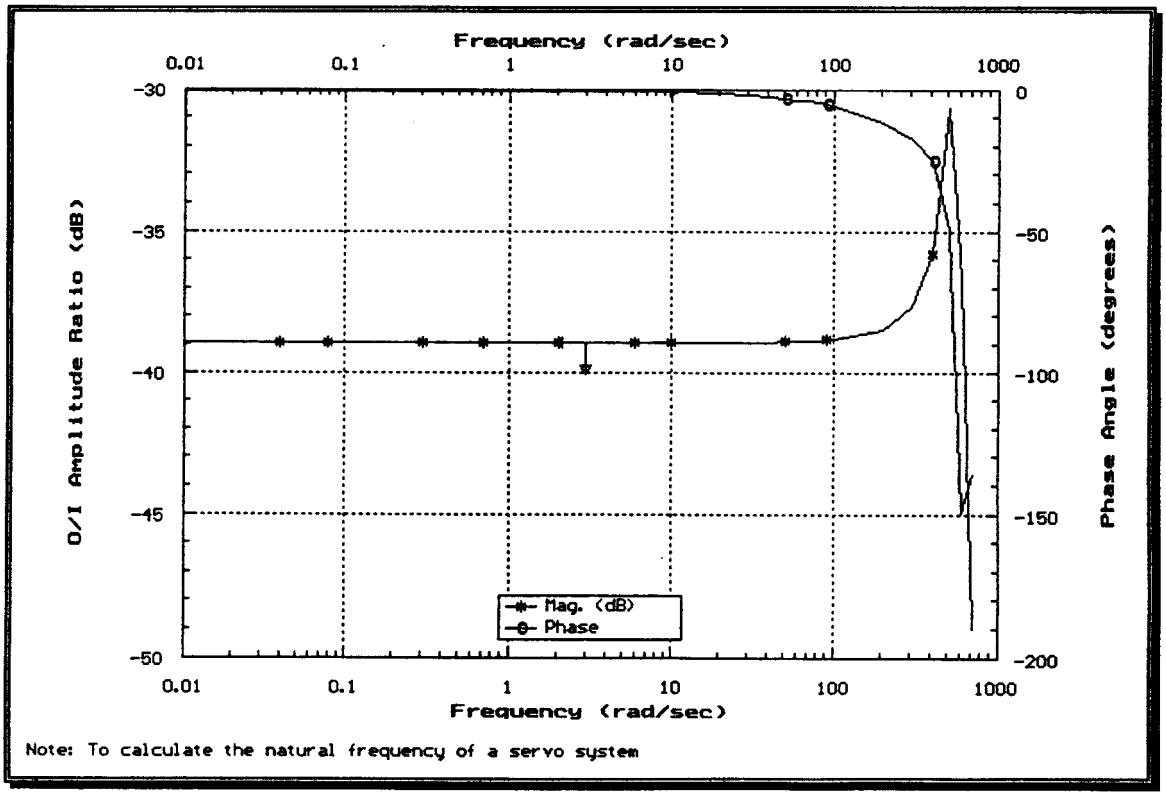

Figure 4.2c. Double Acting Control System Analysis.