Finally, we can consider the interactive effects between the manipulated variables. That is, now that we know the effects of manipulating each variable individually, which combinations of parameter settings work to produce the most efficient algorithm. Figures 11, 12, and 13 summarize these interactive effects. Each figure holds the number of ants constant, and displays the performance of all algorithms that meet that criterion. Figure 11 displays all nine algorithms that used 12 ants, figure 12 displays all nine algorithms that used 25 ants, etc.

Figure 11 - Algorithms with 12 Ants

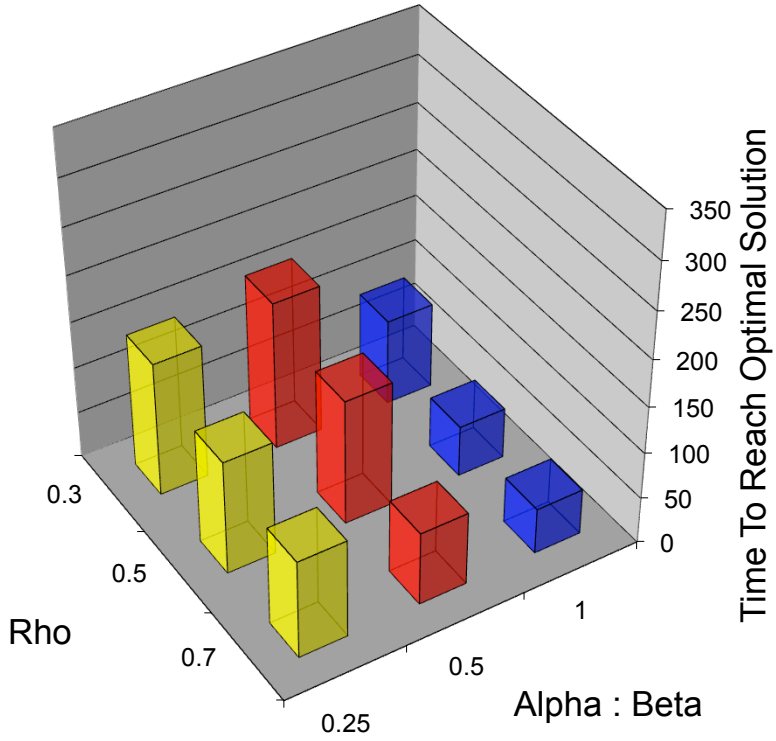


Figure 12 - Algorithms with 25 Ants

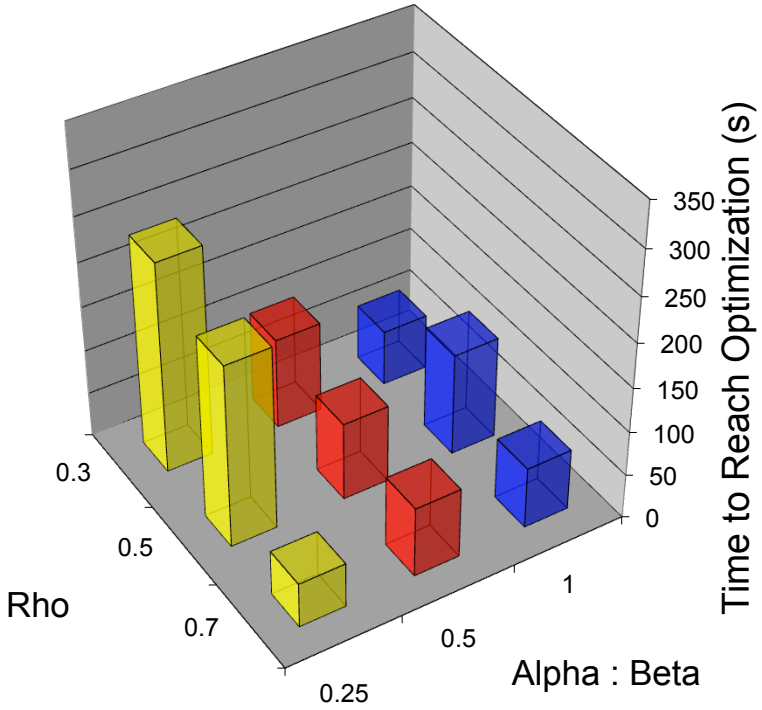
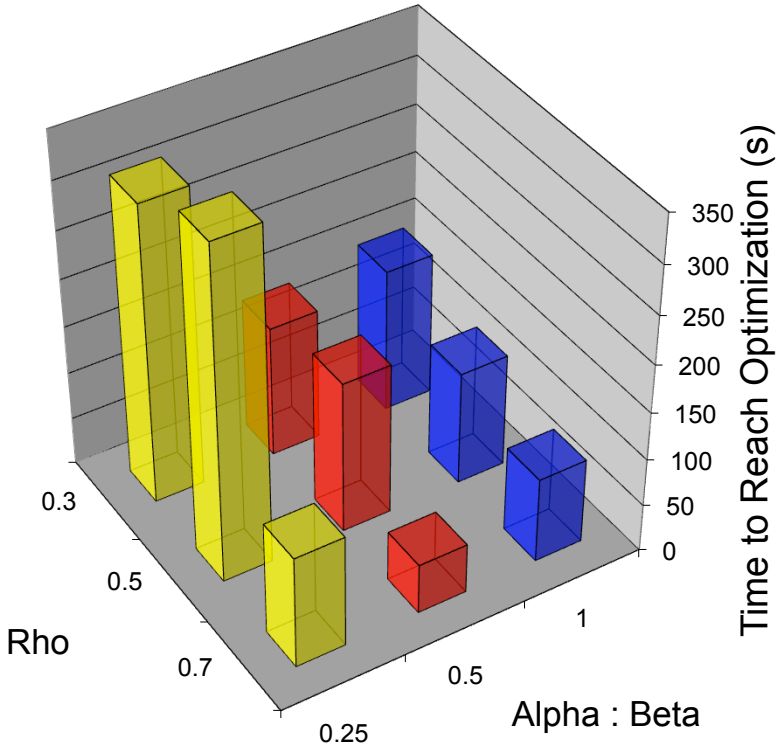


Figure 13 - Algorithms with 50 Ants



Our previous analysis (Figs. 8,9,10) demonstrated that algorithm performance was hindered by increasing the number of ants, decreasing ρ, or decreasing α : β. Figure 13 furthers this analysis by showing that the two most inefficient algorithms (ants = 50, ρ = 0.3, α:β = 0.25 ; ants = 50, ρ = 0.3, α:β = 0.25) had each of these factors working against them. Conversely, based on previous analysis, we would expect that the most efficient algorithm to have a small number of ants, a high ρ value, and a high α : β ratio. And indeed the most efficient algorithm utilized each of these parameter settings (ants = 12, ρ = 0.7, α:β = 1.0; Fig. 11). Thus, both the positive and negative effects exerted by ant number, evaporation rate, and pheromone influence are additive (interactive effects are minimal).