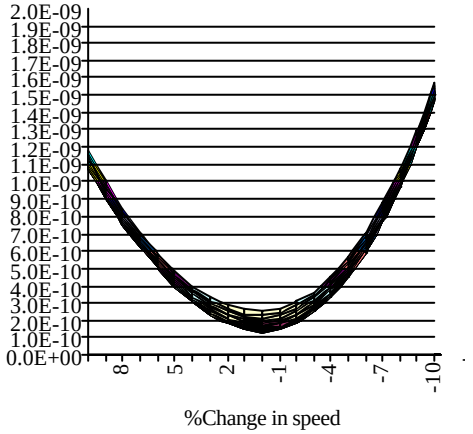
G

ANALYSIS OF OBJECTIVE FUNCTION

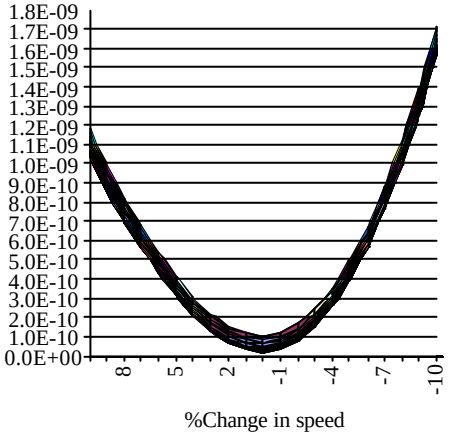
The objective function is illustrated in Figures G.1 to G.6. The following steps are carried out for the generation of these figures:

- Obtain axle weights using static algorithm.
- Obtain axle weights using dynamic algorithm.
- Compare both solutions to known input weights for simulation.
- Plot contours for various parameters in this multi-variable optimisation problem to show how sometimes the solution might be missed.

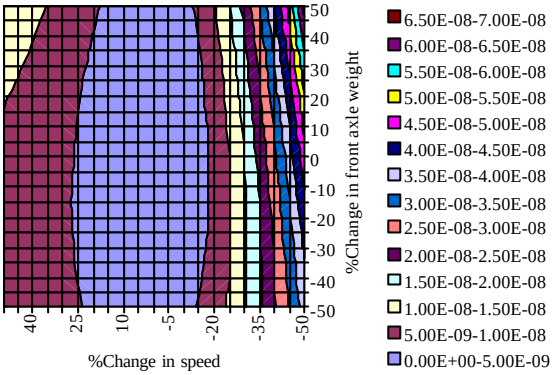
In Figure G.1, front axle weight and speed are varied. A small change in speed has a strong influence on the value of the objective function (more sharp than Figure 7.13). The objective function for the dynamic approach has greater curvature.



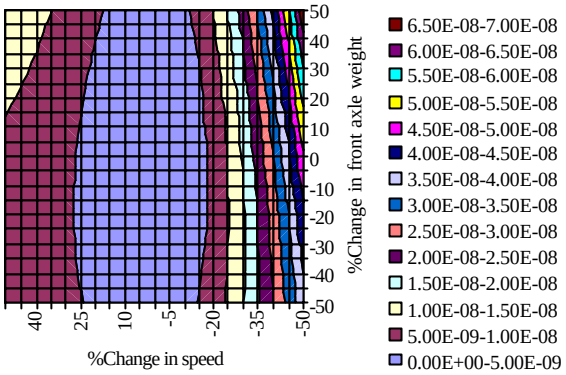
(a) Linear static approach (-10% to 10%)



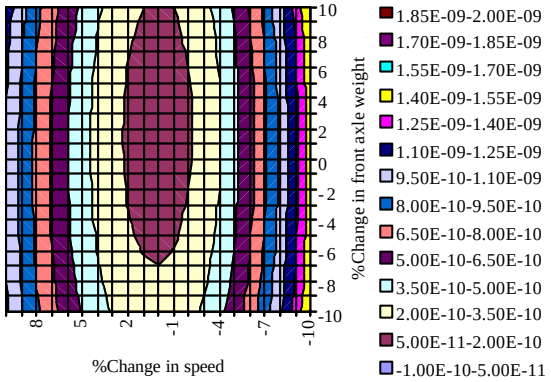
(b) Linear dynamic approach (-10% to 10%)



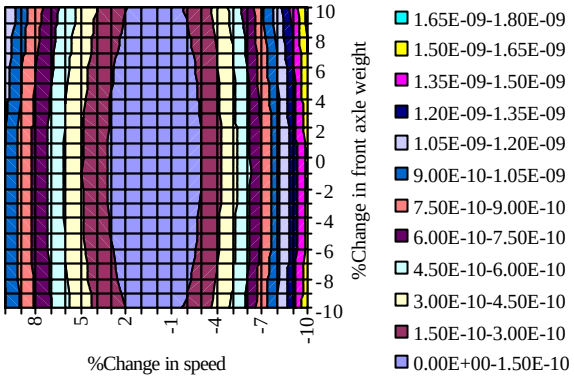
(c) Linear static approach (-50% to 50%)



(d) Linear dynamic approach (-50% to 50%)



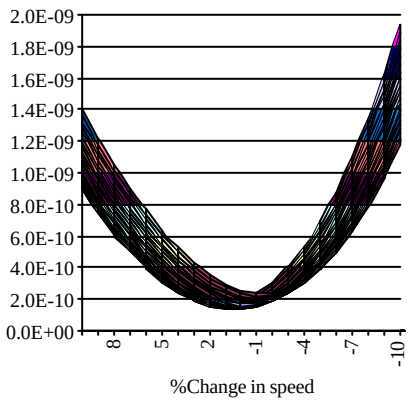
(e) Linear static approach (-10% to 10%)



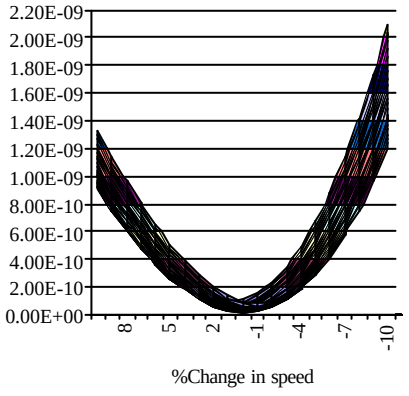
(f) Linear dynamic approach (-10% to 10%)

Figure G.1 - Objective function for variables: Front axle weight and speed

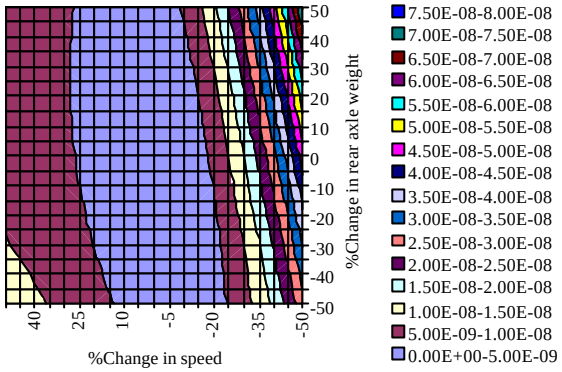
The same conclusions are obtained when rear axle weight and speed are modified (Figure G.2). In this case there is a slight skew in the contours.



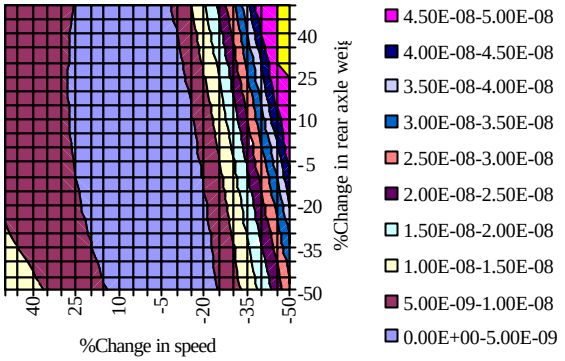
(a) Linear static approach (-10% to 10%)



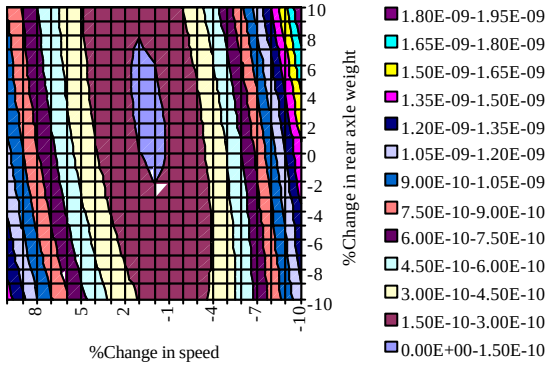
(b) Linear dynamic approach (-10% to 10%)



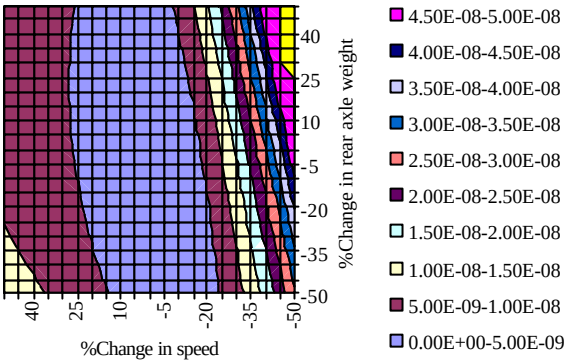
(c) Linear static approach (-50% to 50%)



(d) Linear dynamic approach (-50% to 50%)



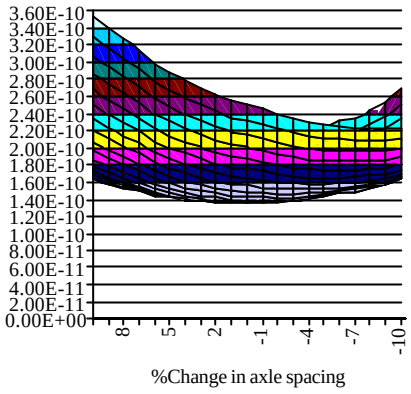
(e) Linear static approach (-10% to 10%)



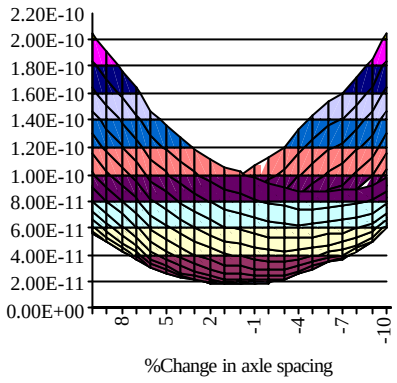
(f) Linear dynamic approach (-10% to 10%)

Figure G.2 - Objective function for variables: Rear axle weight and speed

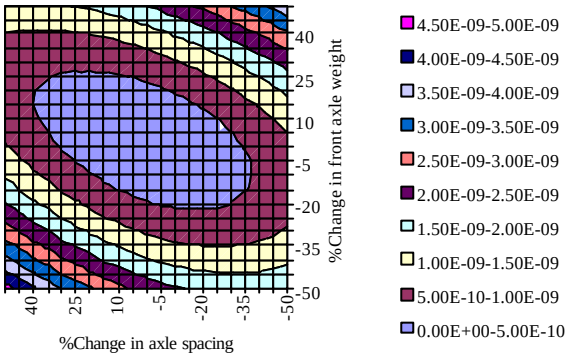
In Figure G.3, the effect of a change in axle spacing and front axle weight on the objective function is analysed. It can be seen that optimisation does not lead a fully accurate solution in the static case. In Figure G.3(e), the ordinate for a 0% change in axle weight meets the 0% change in axle spacing out of the solution area, and about 2% error would result. The dynamic approach finds the exact solution inside the area where the objective function contours are closer. A good estimation of the initial value of axle spacing will speed up the optimisation process.



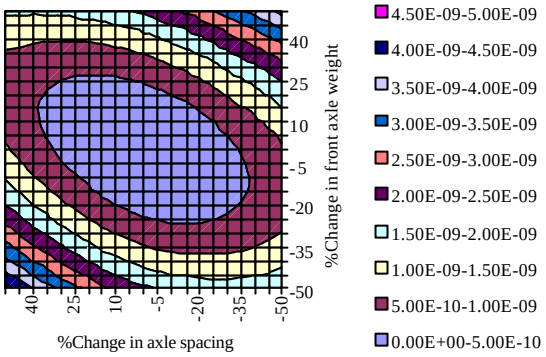
(a) Linear static approach (-10% to 10%)



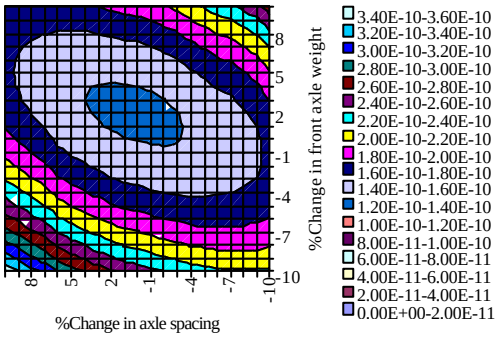
(b) Linear dynamic approach (-10% to 10%)



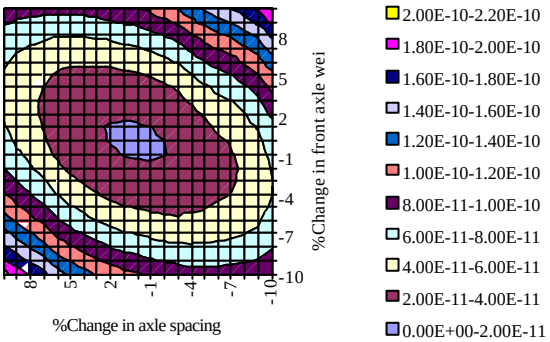
(c) Linear static approach (-50% to 50%)



(d) Linear dynamic approach (-50% to 50%)



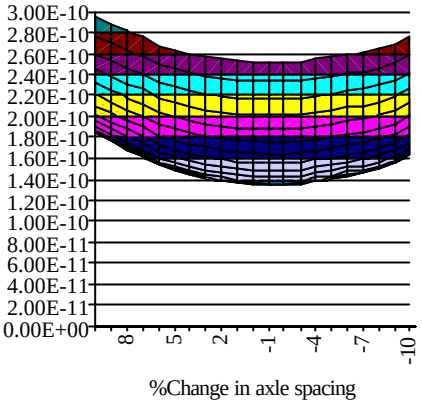
(e) Linear static approach (-10% to 10%)



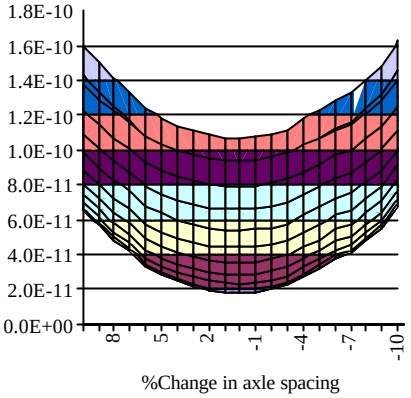
(f) Linear dynamic approach (-10% to 10%)

Figure G.3 - Objective function for variables: Front axle weight and axle spacing

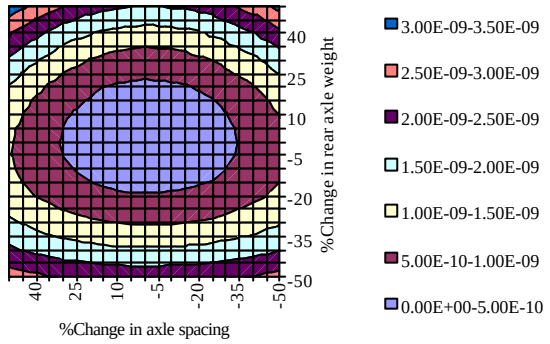
Figure G.4 studies the influence of speed and rear axle weight on the objective function. The same conclusions as before apply.



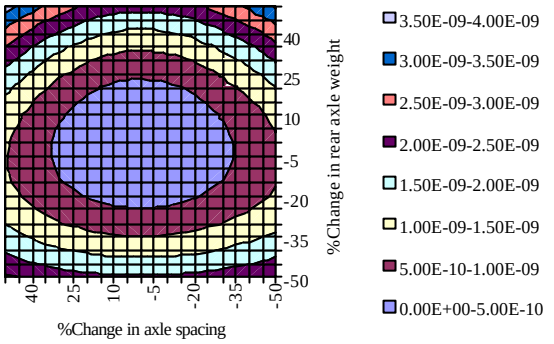
(a) Linear static approach (-10% to 10%)



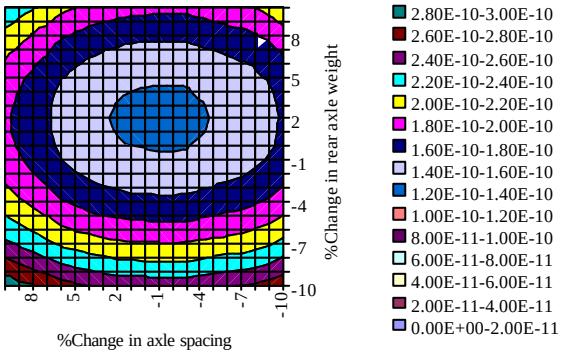
(b) Linear dynamic approach (-10% to 10%)



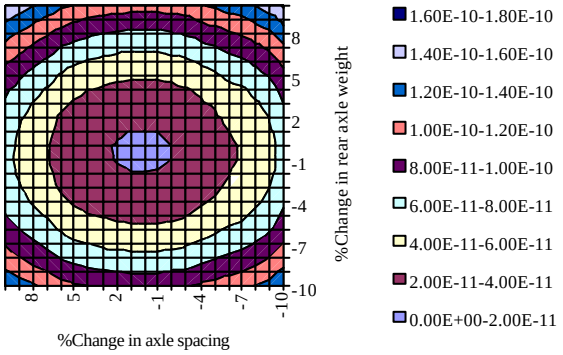
(c) Linear static approach (-50% to 50%)



(d) Linear dynamic approach (-50% to 50%)



(e) Linear static approach (-10% to 10%)

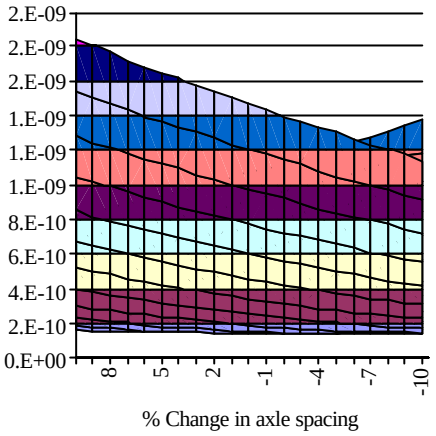


(f) Linear dynamic approach (-10% to 10%)

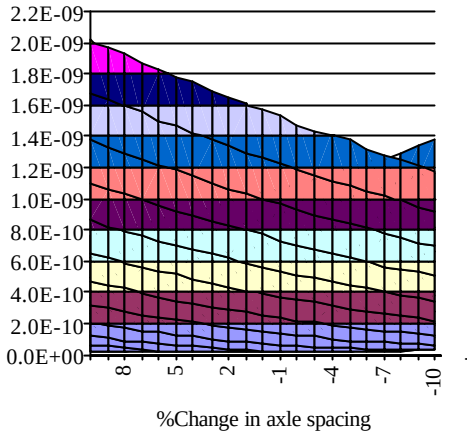
Figure G.4 - Objective function for variables: Rear axle weight and axle spacing

Finally, Figure G.5 shows the influence of axle spacing and speed. A small error in any of these two variables has a very negative effect on the final accuracy of both algorithms. Speed

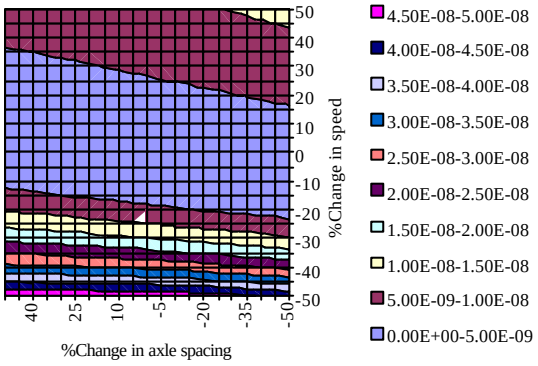
and axle spacing appear to be dependent, and there is insufficient to solve for both using optimisation.



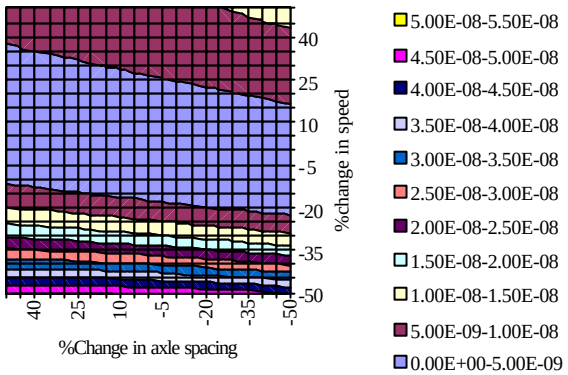
(a) Linear static approach (-10% to 10%)



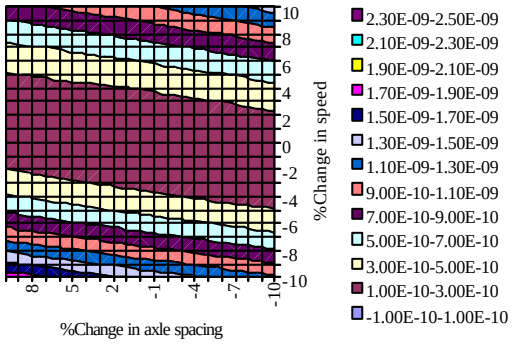
(b) Linear dynamic approach (-10% to 10%)



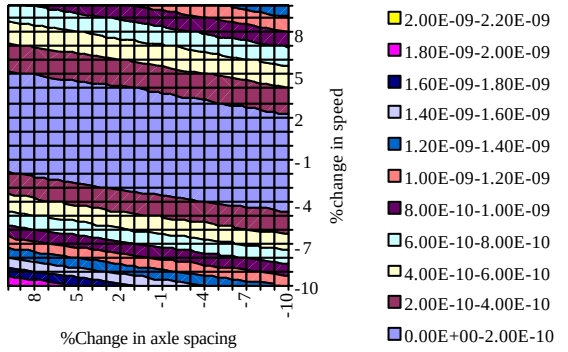
(c) Linear static approach (-50% to 50%)



(d) Linear dynamic approach (-50% to 50%)



(c) Linear static approach (-10% to 10%)



(d) Linear dynamic approach (-10% to 10%)

Figure G.5 - Objective function for variables: Speed and axle spacing