

ABSTRACT

Underbody plows can be very useful tools in winter maintenance, especially when compacted snow or hard ice must be removed from the roadway. By the application of significant down-force, and the use of an appropriate cutting edge angle, compacted snow and ice can be removed very effectively by such plows, with much greater efficiency than any other tool under those circumstances.

However, the successful operation of an underbody plow requires considerable skill. If too little down pressure is applied to the plow, then it will not cut the ice or compacted snow. However, if too much force is applied, then either the cutting edge may gouge the road surface, causing significant damage often to both the road surface and the plow, or the plow may ride up on the cutting edge so that it is no longer controllable by the operator. Spinning of the truck in such situations is easily accomplished. Further, excessive down force will result in rapid wear of the cutting edge.

Given this need for a high level of operator skill, the operation of an underbody plow is a candidate for automation. In order to successfully automate the operation of an underbody plow, a control system must be developed that follows a set of rules that represent appropriate operation of such a plow. These rules have been developed, based upon earlier work in which operational underbody plows were instrumented to determine the loading upon them (both vertical and horizontal) and the angle at which the blade was operating.

These rules have been successfully coded into two different computer programs, both using the MatLab® software. In the first program, various load and angle inputs are analyzed to determine when, whether, and how they violate the rules of operation. This program is essentially deterministic in nature. In the second program, the Simulink® package in the MatLab® software system was used to implement these rules using fuzzy logic. Fuzzy logic essentially replaces a fixed and constant rule with one that varies in such a way as to improve operational control. The development of the fuzzy logic in this simulation was achieved simply by using appropriate routines in the computer software, rather than being developed directly.

The results of the computer testing and simulation indicate that a fully automated, computer controlled underbody plow is indeed possible. The issue of whether the next

steps toward full automation should be taken (and by whom) has also been considered, and the possibility of some sort of joint venture between a Department of Transportation and a vendor has been suggested.