



Caltrans Division of Research,
Innovation and System Information

Research

Notes

Equipment

FEBRUARY 2023

Project Title:
Investigating Teleoperated Equipment
for Use in Caltrans Operations

Task Number: 3869

Start Date: December 1, 2021

Completion Date: December 30, 2023

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Investigating Teleoperated Equipment for Use in Caltrans Operations

Investigating the operations of non-line-of-sight remote control technology for Caltrans operations.

WHAT IS THE NEED?

Advances in the field of teleoperated / autonomous vehicles has shown potential for new and innovative applications that could change how State Departments of Transportation (DOT's) maintain roadways and roadside vegetation, and roadway and roadside construction, among other operations. Mowing of medians and right-of-way is an important vegetation management practice for Caltrans, but it is labor intensive and requires expensive and specialized equipment.

With the advent of teleoperated/ autonomous vehicles, it may be possible to reduce worker's exposure and risk by utilizing driverless tractors for mowing operations. In addition, cost savings are also possible by utilizing one operator to control more than one mower.

WHAT ARE WE DOING?

The research will assess ease of use, safety, and appropriateness of non-line-of-sight, remote control/autonomous technology for Caltrans maintenance operations. The project tasks include:

1. Literature Review
2. Draft Specifications/Requirements
3. Assess and Verify Industry Capability
4. Caltrans demonstration

WHAT IS OUR GOAL?

The goal of this study is to demonstrate in the field, a vehicle capable of meeting the requirements for teleoperated / autonomous vehicles as requested by the Division of Equipment.



DRISI provides solutions and
knowledge that improves
California's transportation system

WHAT IS THE BENEFIT?

The benefit of this research to California is increased worker safety. Implementation of this technology would allow a maintenance worker to control the vehicle (i.e., mower in this instance) from a safer location while mowing “steep” grades along the state right of way. Furthermore, labor costs may be reduced by having one operator controlling multiple mowers.

WHAT IS THE PROGRESS TO DATE?

- Questionnaire completed to gain a better understanding of other DOTs needs to add to the draft specification created for Caltrans to send to original equipment manufacturers (OEM). Received responses from 23 different state agencies.
- The researchers completed draft specifications that can help assess what equipment OEMs may have (or may not have) that will satisfy Caltrans needs and requirements.
- The researchers completed Interim report summarizing work to date completed.
- The researchers conducted a field inspection with Caltrans staff to assess possible demonstration sites for vendors.

IMAGES

Companies Contacted to Date:

- Contacted a newly established company (MACH)
- Followed up again with:
 - Case/New Holland
 - John Deere
 - Monarch
 - Phantom
 - Raven Autonomy



Image 1: List of OEMs contacted

Do you mow in the rain?		At what wind speed do you stop mowing?	
Response	Count	Response	Count
Certain circumstances (please elaborate)	11	10 mph +	5
No	56		
Yes	6	15 mph +	8
Blanks	16		
How long after rain do you resume mowing?		20 mph +	5
Time Frame	Count	25 mph +	1
1-2 hours (as long as conditions warrant)	2	30 mph +	2
1-2 days	16		
2-3 days	12	Depends on temperature and humidity (i.e. fire danger)	2
4-5 days	5	Follow HQ Fire Danger	6
1 week	3	Depends on dust and visibility	3
Up to two weeks	1	Rating	2
Depends on conditions, but generally when dry and not muddy	18		
Unknown or comment not related	3		
Blank	23		
Do you mow below 32 degrees?			
Response	Count		
Blank	16		
Certain circumstances (please elaborate)	9		
No	51		
Yes	13		

Image 2: Example of Survey Results - Weather Responses Summarized

Narrowest Area Mowed		Widest Area Mowed		Heights that Vegetation is Mowed to		Miles of ROW Mowed	
Response	Count	Response	Count	Response	Count	Response	Count
Blank	17	Blank	17	Blank	17	Blank	21
1 foot	2	Under 10"	6	2"	1	None or not much	2
2 feet	8	10-20"	4	2-3"	1	<100	21
3 feet	5	20-30"	12	2-4"	1	100-200	15
4 feet	13	30-40"	16	4"	18	200-300	10
5 feet	1	100-200"	16	4-6"	12	300-400	7
6 feet	15	200-300"	7	4-8"	1	400-500	1
8 feet	14	300-500"	1	4-12"	2	500+	3
9 feet	1	500+	2	6"	20	Other	4
10 feet	3	Other answer	11	6-8"	1	Unknown	3
12 feet	5			6-12"	1	Don't Mow	2
15 feet	1			8"	1		
16 feet	1			8-12"	1		
25 feet	2			10"	1		
100 feet	1			12"	1		
				12-15"	1		
				24"	2		
				60"	1		
				72"	1		
				0-20"	1		
				3800"	1		
				Other answer	1		

Image 3: Example of Survey Results – Roadside Characteristics Responses Summarized

- Most obstacles in survey were encountered. Other objects include:

- Environmentally sensitive areas
- Irrigation
- Large litter & debris from illegal dumping (e.g. mattress)
- Survey markers
- Foreign/unknown objects
- Hidden objects
- Large rocks
- Utility polls
- Guardrail
- Tree stumps
- Dirt humps
- Well heads

- Entered traffic to avoid obstacles 1-5x per mile

Response	Count
Blank	23
1 time	18
2-3 times	22
3-4 times	9
4-5 times	2
More than 5 times	15

Response	Count
Blank	17
Barrier, including sound walls	65
Bridges	66
Culverts	71
Drainage ditches/rip-rap	71
Electrical boxes	69
Guide markers	70
Homeless encampments	44
Roadside debris (e.g. tires)	60
Sign posts and structures, including billboards	72
Stalled or crashed vehicles	38
Trees	71
Other objects	15

Image 4: Example of Survey Results – Obstacles encountered

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