Limits of trafficability on forest soils. Influencing parameters on rutting.

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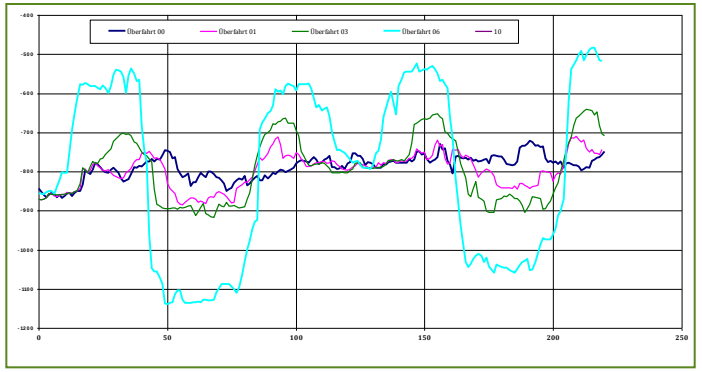
Outline

1. Rut development
2. Measurements and mathematical function
3. Results
4. Conclusion

Development of ruts



Machine parameter

- Wheel slip
- Tyres and traction equipment
- Ground pressure

Soil parameter

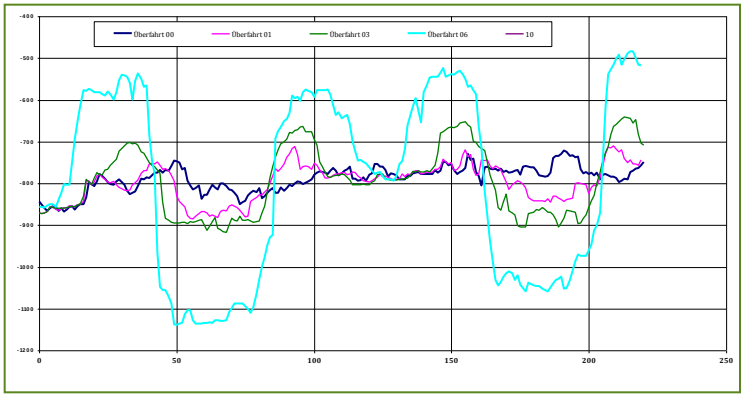
- Soil type
- Grain size
- Soil water content
- Bulk density
- Shear strength
- Humus layer/ content
- Root system

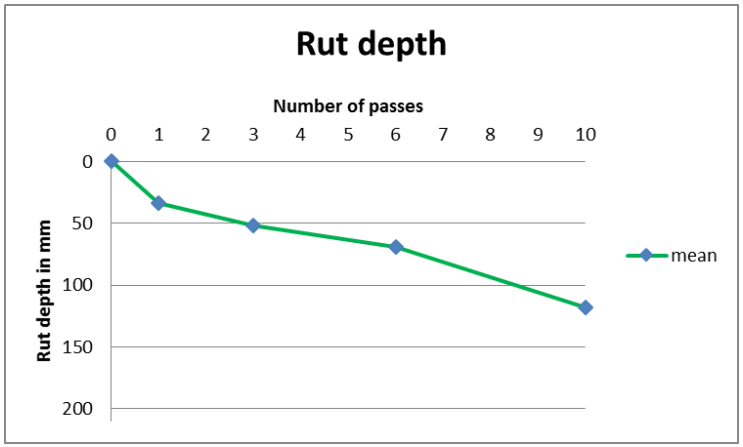
Project

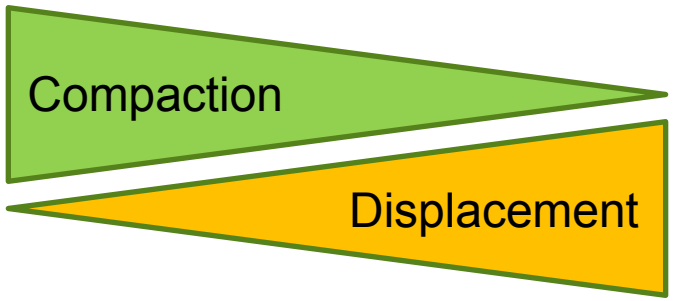
„Influence of wheel load and wheel slip on rutting in forest operations“

Identified factors for rutting processes

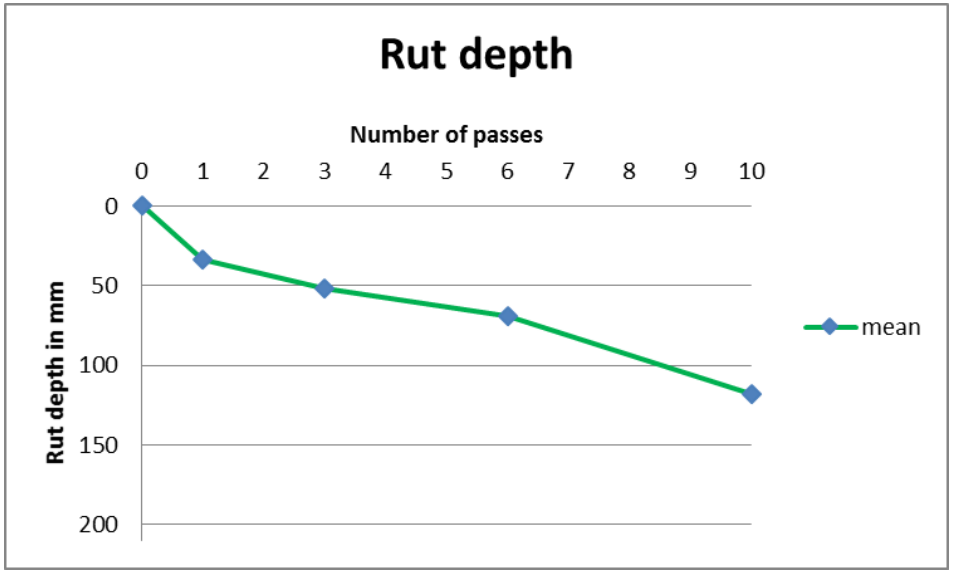
- Number of passes
- Soil water content
- Humus content
- Wheel slip

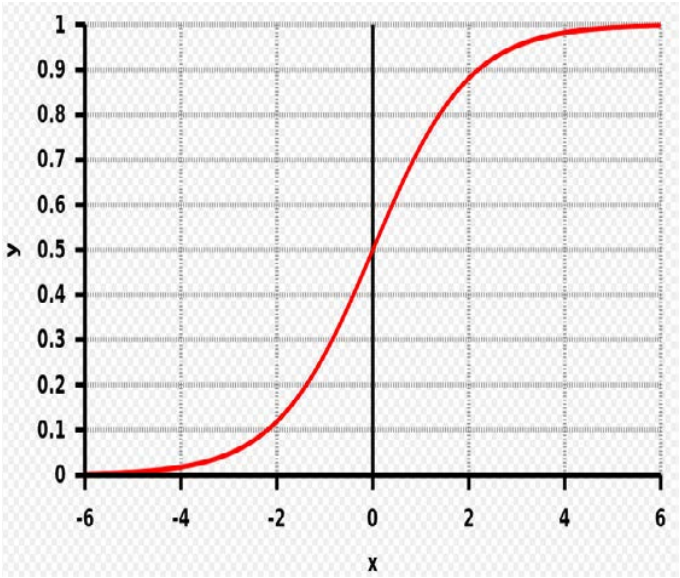






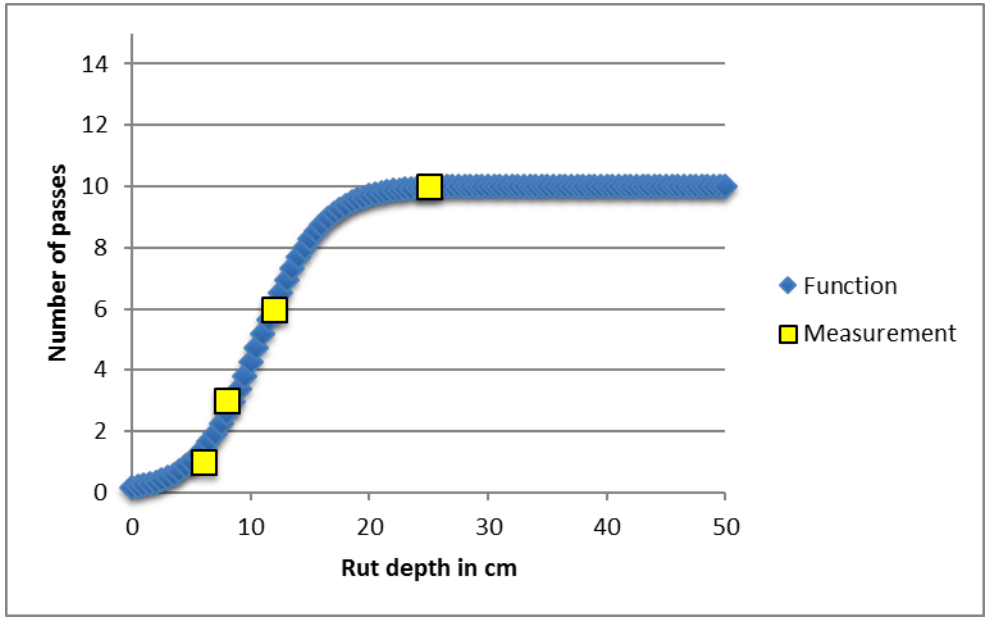
Function

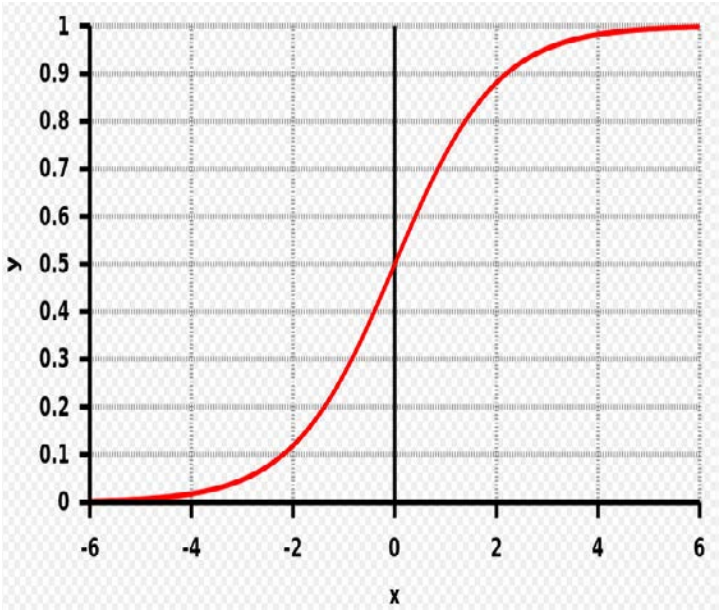




$$f(t) = G * \frac{1}{1 + e^{-k*G*t}\left(\frac{G}{t(0)} - 1\right)}$$

Function



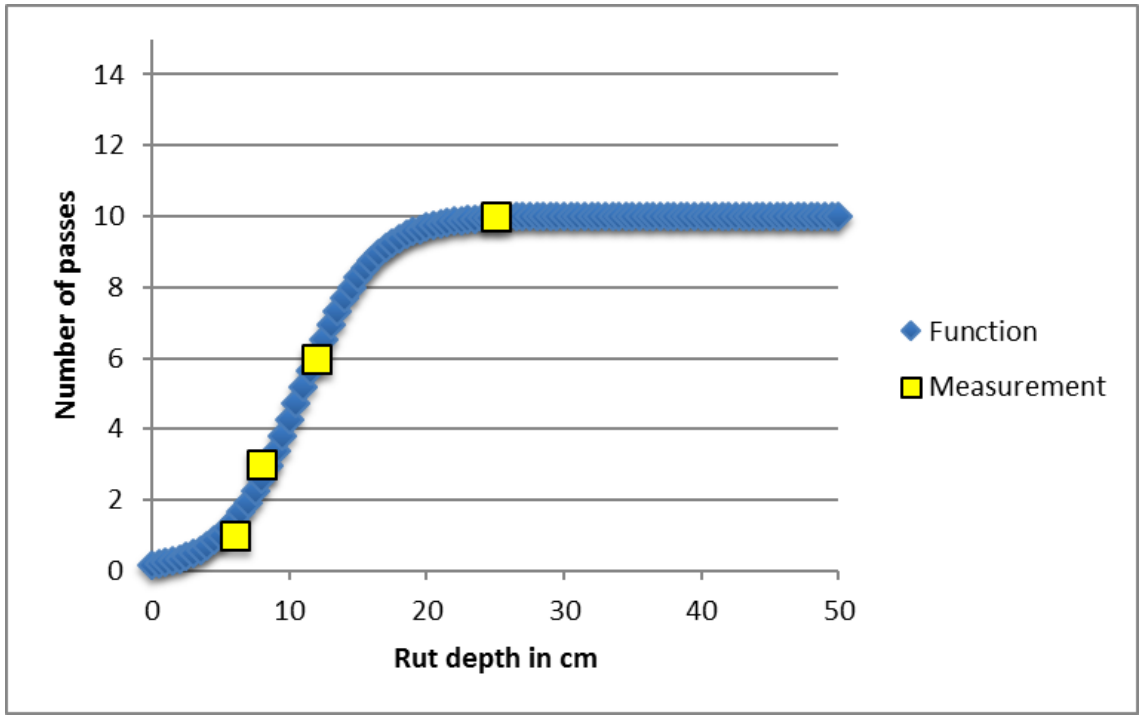


Number of passes	Rut depth
0	0
1	6
3	8
6	12
10	25

Parameter		Value
G	curve max. value	10,02691404
k	steepness	0,037307414
t(0)	rut depth at inflection point	8,192484275
f(t)	passes at inflection point	2,736887045
a	Δ (G-f(t))	3,663619971
r	diviation	0,297641814

$$f(t) = G * \frac{1}{1 + e^{-k*G*t}\left(\frac{G}{t(0)} - 1\right)}$$

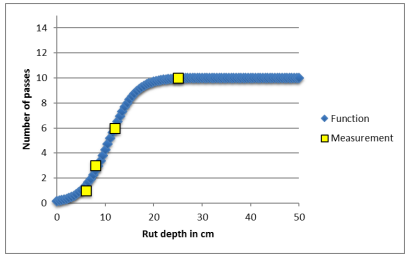
Function



Soil parameters
- Bulk density
- Humus content
- Water content
- Grain size
- Humus layer

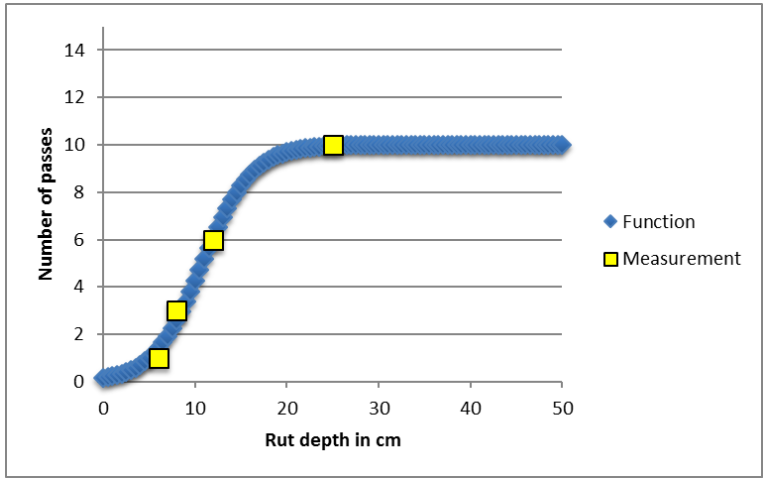
Machine parameters
- Wheel load
- Wheel slip
- Machine configurations (tyres &tracks)

Function


Number of passes
Rut depth in cm
Function
Measurement

t
Humus layer
f
Wheel slip
Water content
Bulk density
a
Machine configuration
Humus content
Wheel load
k
Grain size

Result



	k	f(0)	t(0)	a
Water content	-	-	+	
Humus content	-		+	+
Grain size	+		-	+
Bulk density	+		-	-
Humus layer			-	
Wheel load	-			
Wheel slip		-	+	-
Machine configuration	-	+		+

Result:

k	↓	= increasing rut depth
f	↑	= max. value of curve (G) increases
t	↑	= max. value of curve (G) decreases
a	↑	= max. value of curve (G) increases

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Conclusion

- Is it possible to describe the process of rut development as a mathematical function?
  - **Yes it is!**
- Is it possible to make a prediction under certain conditions?
  - **Under certain conditions!**
  - Much more samples

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Results – rut depth