



Accuracy enhancement of the real time location System Ubisense Series 7000



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Introduction

- Rising impact of automatic behavior analysis in dairy production
 - high Input – high Output System
 - increasing stock sizes
- Real Time Location System (RTLS) – growing use in manufacturing and control processes
- RTLS in dairy production
 - Improving of herd management
 - Worker productivity
 - Detection of lameness
 - Analysis of changes in daily behavior
 - Advances in experimental technique



Objectives

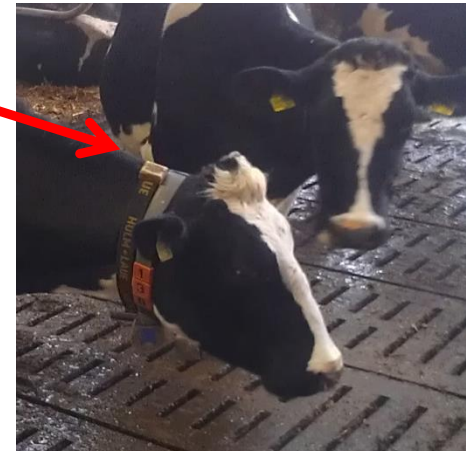
1. Possible accuracy and influences
2. Determination of the precision of the behavior observation
3. Effect of claw disorders on the behavior
4. Analysis of the periodicity of behaviors and changes during the lactation

Material and Methods

- RTLS Ubisense Series 7000
 - „Sensors“ + „Tags“
 - UWB – signal (6-8 GHz) + 2,4 GHz for controlling
 - Methods: *Angle of Arrival* and *Time Difference of Arrival*
 - Accuracy by manufacturer: 30 cm



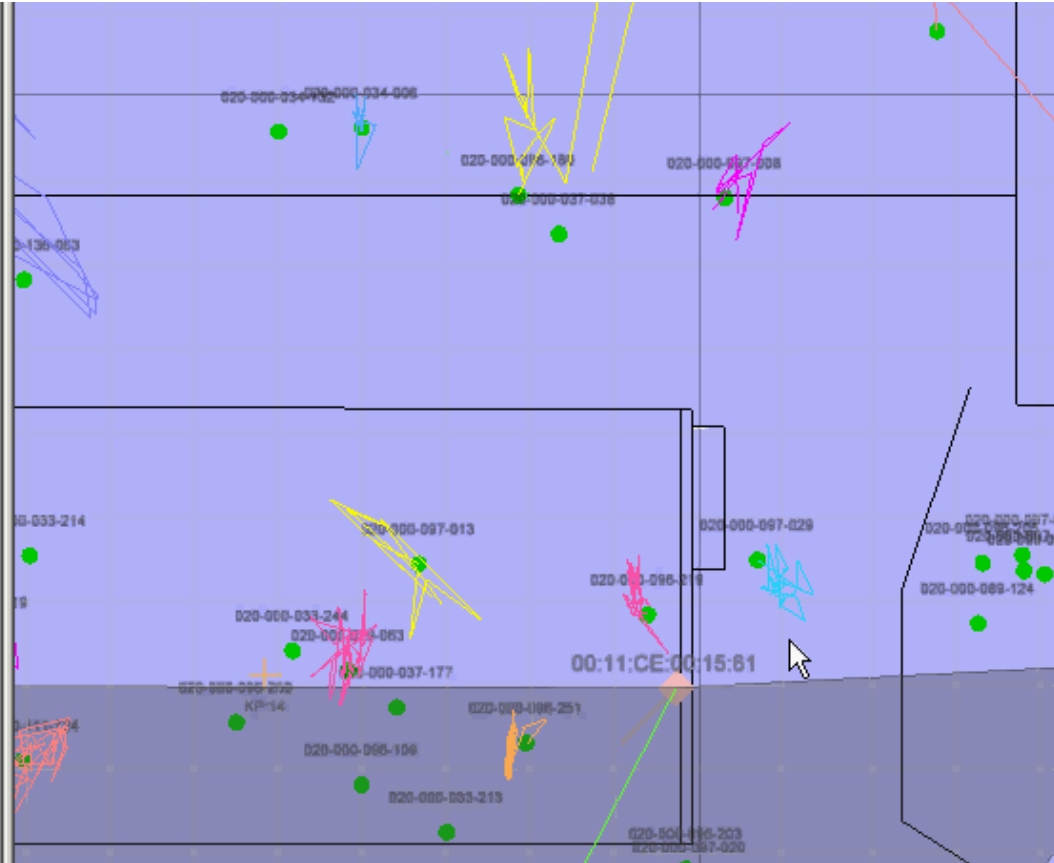
N.N., 2009a





Material and Methods

Comparison of Video and RTLS





Material and Methods

- Experimental Design

- Calibration point „M“

- **Sensorlayout=**

- 2-8 Sensors (S1-S8) in 16
Layouts and 2 vertical levels

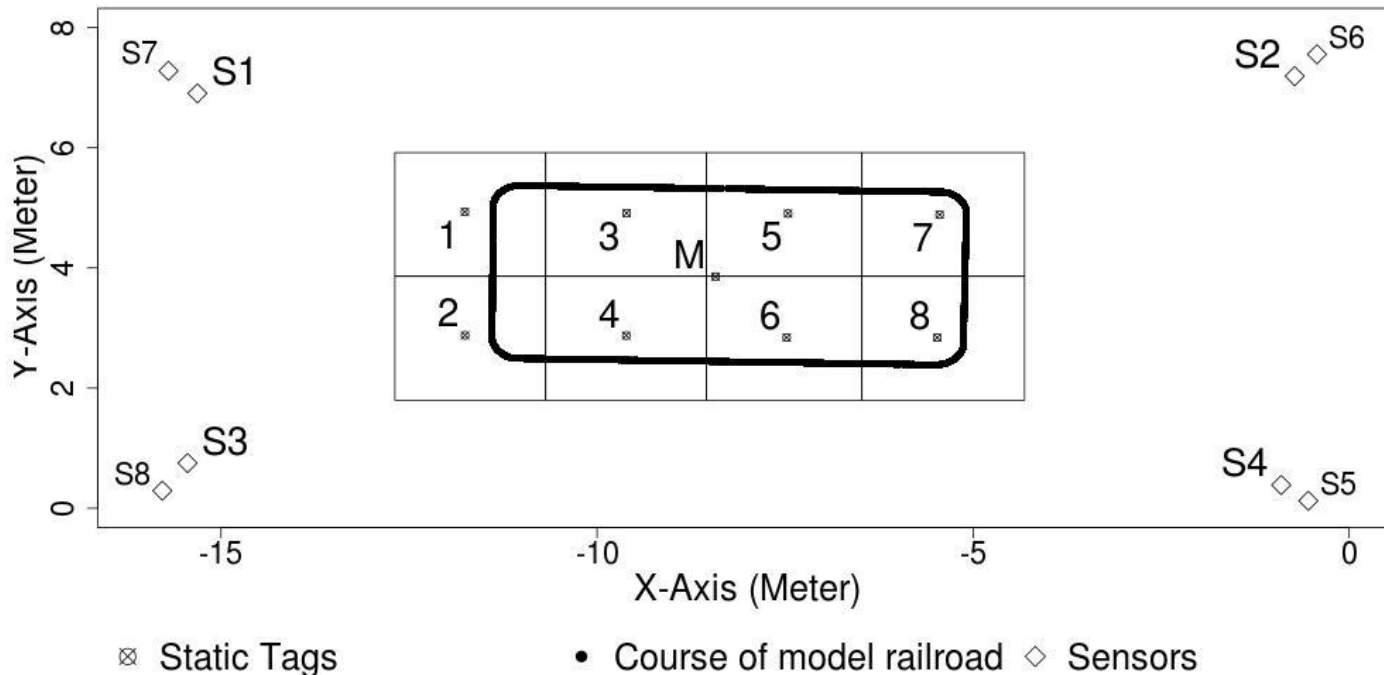
- **Speed**

- (0,4m/s, 0,5m/s, 0,6m/s)

- **quadrant (1-8)**

- **Status of Tags –**
static / dynamic (3 Tags)

- Target variable: Euclidean distance in meters





Material and Methods

- Logarithms of raw data
- SAS procedure Mixed
- Fixed effects (n=142.375)
 - Sensorlayout (1-16)
 - Speed (1-3)
 - Status of Tags (1-4)
 - Quadrant (1-8)plus all interactions of these effects
- Interaction of Sensorlayout x Speed x Round as random effect

All Interactions have highly significant effect ($p < 0.0001$)

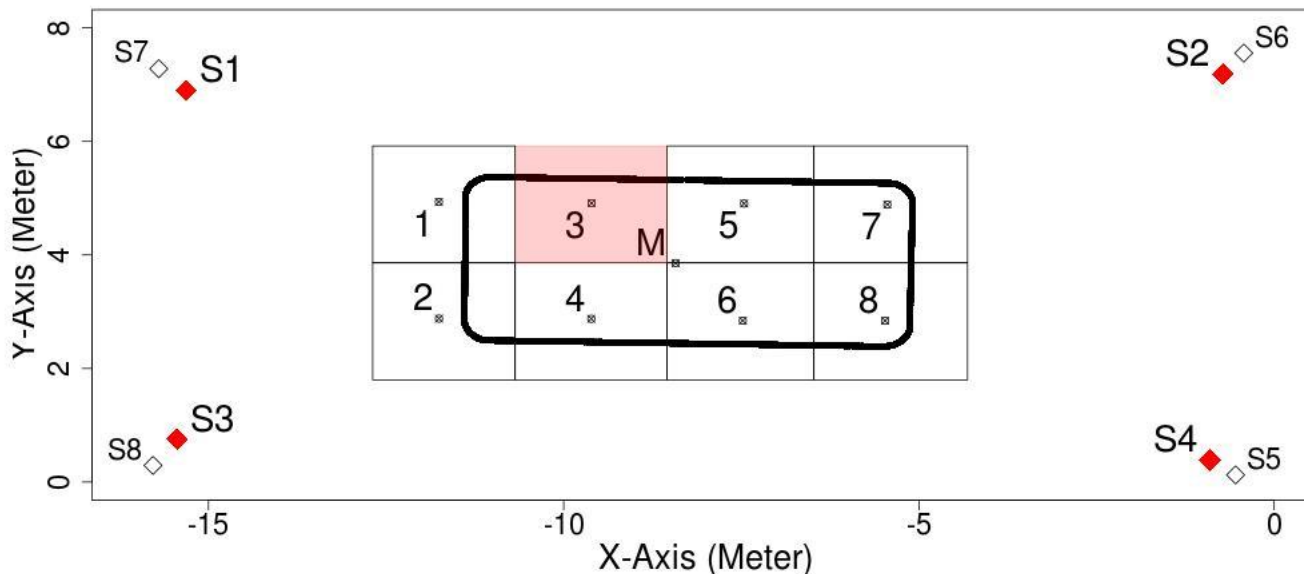
- Only interpretation of interaction of:
Sensorlayout x Speed x Status of Tags x Quadrant



Results

Back transformed LSMEANS in meters euclidean Distance of Interaction of Sensorlayout (1), Speed (1-3), Quadrant (3) and Status of Tags (dynamic 1-3, static)

Speed	dynamic			static
	1	2	3	
1 (~0,4m/s)	0.114	0.132	0.128	0.058
2 (~0,5m/s)	0.134	0.149	0.147	0.044
3 (~0,6m/s)	0.195	0.158	0.198	0.054



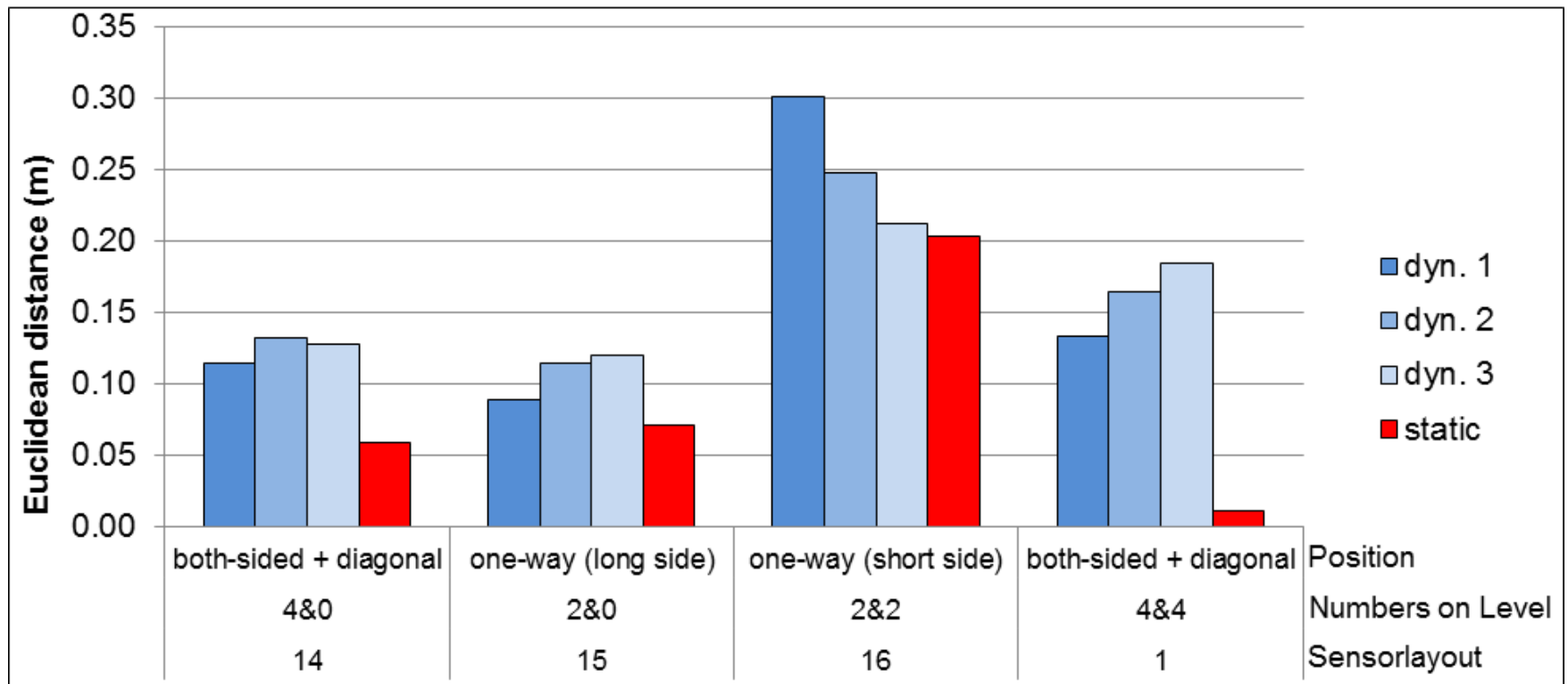
⊗ Static Tags

• Course of model railroad ◇ Sensors



Results

Back transformed LSMEANS in meters euclidean Distance of Interaction of Sensorlayout (1,4,10,13), Speed (1), Quadrant (3) and Status of Tags (dynamic 1-3, static)





Discussion

- Status of Tags and Speed
 - No relevant differences between the speeds at the static variants
 - Variations within dynamic variants very small
 - Speed causes differences up to 0.11m
 - Differences between Quadrants present
- Sensorlayout
 - Variants with 4 or more Sensors on consistent level
 - Diagonale Layouts better then one-sided



Conclusion

- RTLS Ubisense Series 7000 shows very high tracking accuracy
- Big differences between dynamic and static measurement
- Open Questions:
 - Influence of steel and water
 - Improvement of 3 dimensional accuracy
- Usage for behavior analysis in dairy production?!!!



Thank you for your attention

