Resumen Papers
DAMAVA

20 de junio de 2017

1. Medidores de Desempeño

TP	Casos de mastitis subclínica correctamente clasificados
FP	Casos sanos clasificados erróneamente.
FN	Casos de mastitis subclínica clasificados erróneamente.
TN	Casos sanos correctamente clasificados.

Cuadro 1: Clasificación de resultados

$$Sensibilidad = \frac{TP}{TP + FN} \qquad Especificidad = \frac{TN}{TN + FP} \qquad Error = \frac{FP}{FP + TP}$$

2. [1]

2.1. Métodos para el tratamiento de la serie temporal

- **Media movil**:

$$Y'_t = \frac{1}{N} \sum_{k=1}^{N} Y_{t-k} \qquad N = 10$$

- **Media movil exponencial con peso**:

$$Y'_t = \alpha Y_{t-1} + (1 - \alpha) Y'_{t-1}$$

  Cuanto mayor el valor de α, mayor es el peso de los últimos valores. Se testearon los siguientes valores de $\alpha = \{0{,}2; 0{,}4; 0{,}6; 0{,}8\}$

- **Regresión local con peso**

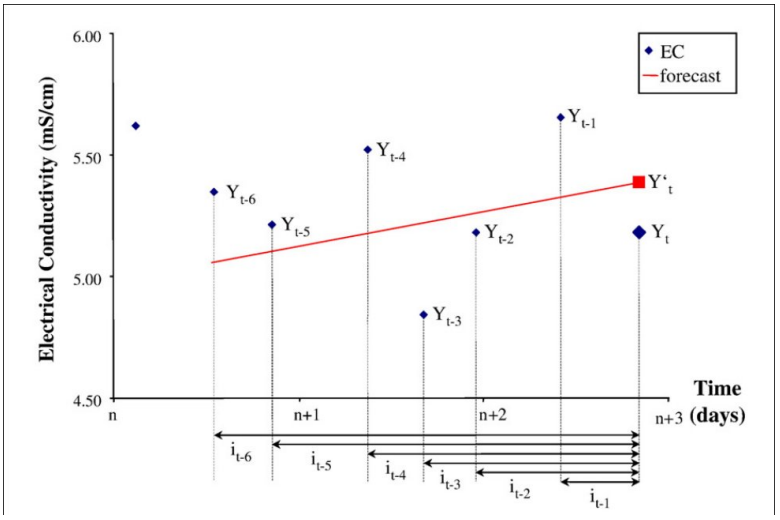

Figura 1: Ejemplo de ajuste de polinomio.

2.2. Resultados

Treat+ 100	Threshold	Block-sensitivity	Specificity	Error rate	TP cows/ day	FP cows/ day
MA	7%	84.7	73.0	56.2	12.3	15.7
EWMA	7%	83.6	73.4	56.0	12.2	15.5
LOESS	5%	87.9	66.6	60.4	12.8	19.5
Treat+ 400	Threshold	Block-sensitivity	Specificity	Error rate	TP cows/ day	FP cows/ day
MA	9%	86.1	81.4	83.3	3	15.1
EWMA	9%	85.0	81.6	83.2	3	15.0
LOESS	6%	85.0	74.5	87.4	3	20.8

Figura 2: Resultados para el umbral óptimo.

3. [2]

Existen los siguientes sistemas de detección de mastitis:

- **Lactate**

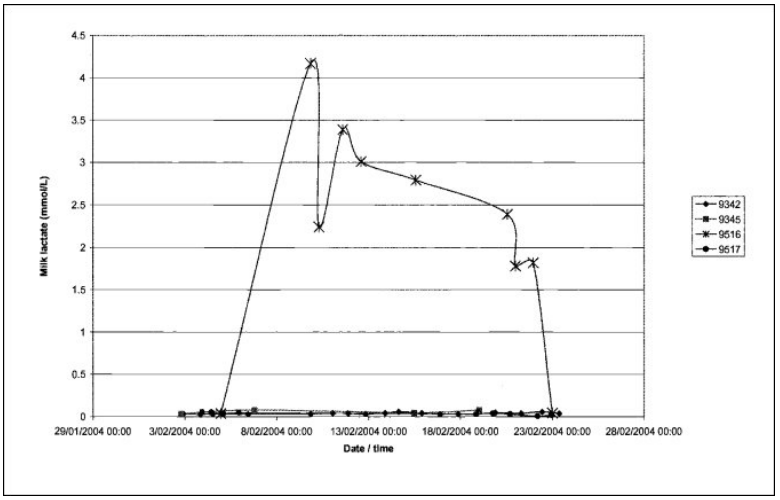

Figura 3: Una vaca que tuvo una infección la cual se curo sola(?)(self-cured) después de un periodo de 18 días.

- **SCC** En la figura 4 se observan los resultados de un direc online SCC sensor.

Table 1 **Summary of SCC sensor prototype performance: time-to-drain thresholds, the total number of milk samples (n), and the number of correct ($n_{correct}$) and proportion of correct (p) measurements from the calibration and on-line testing.**

SCC band (kcells/ml)	Time-to-drain thresholds (s)	n (lab)	$n_{correct}$ (p) (lab)	n (on-line)	$n_{correct}$ (p) (on-line)
<200	<1.1	38	36 (95%)	64	62 (97%)
200 – 500	1.1 – 1.7	39	33 (85%)	2	2 (100%)
500 – 1500	1.7 – 6.2	59	45 (76%)	2	1 (50%)
1500 – 5000	6.2 – 59	60	43 (72%)	0	0 N/A
>5000	>59[1]	42	40 (95%)	1	1 (100%)
Overall	N/A	238	197 (83%)	69	66 (96%)

Figura 4

- **Conductividad del cuarto**

4. [3]

4.1. CE

ver [4]

4.2. Mediciones de sangre online

Blood in milk is a very good indicator of udder injury, including mastitis, and milk should be diverted from the milk line.

4.3. Online Somatic Cell Count

DeLaval has launched an online Somatic Cell Counter for the Delaval VMS.

4.4. Combined mastitis indices

Steenevold et al. (5) investigated the combined use of electrical conductivity and on-line measurements of somatic cell counts. The addition of somatic cell count data moved the success rate of mastitis detection to 32 %, but moved the specificity to 98.8 %.

4.5. Measurement and interpretation of Lactate Dehydrogenase

5. [4]

5.1. Introduction

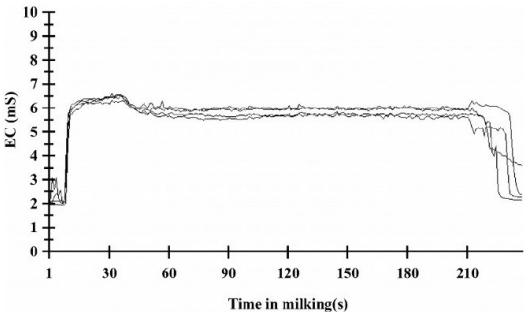

Figure 1. Electrical conductivity (EC) profiles (in milliSiemens [mS]) for all 4 quarters of a healthy cow.

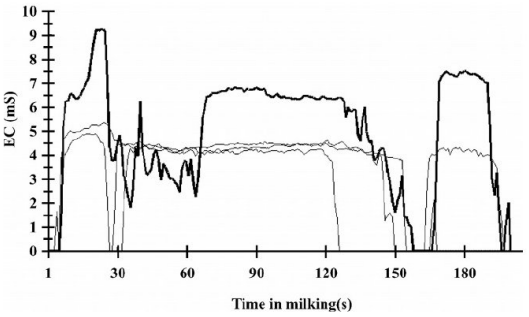

Figure 2. Electrical conductivity (EC) profiles (in milliSiemens [mS]) for all 4 quarters of a cow with clinical mastitis. The bold line indicates the EC profile of the infected quarter.

Figura 5

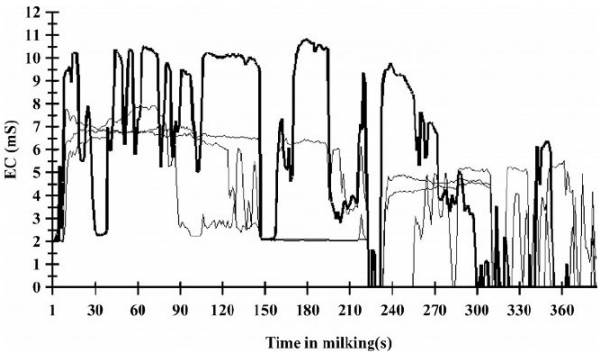

Figure 3. Electrical conductivity (EC) profiles (in milliSiemens [mS]) for all 4 quarters of a cow with clinical mastitis. The bold line indicates the EC profile of the infected quarter.

Figura 6

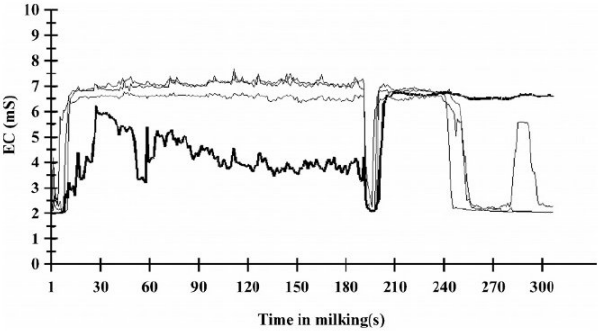

Figure 4. Electrical conductivity (EC) profiles (in milliSiemens [mS]) for all 4 quarters of a cow with clinical mastitis. The bold line indicates the EC profile of the infected quarter.

Figura 7

5.2. Results

5.2.1. Level and Variation of EC measurements

Electrical conductivity results obtained at the quarter level are given in 8.

Table 1. Distributions of electrical conductivity values (means ± standard errors) for healthy, subclinically and clinically infected quarters.

	Healthy	Subclinical	Clinical
no.	10,431	2122	599
X_{20}[1]	$4.87^{a} \pm 0.01$	$5.37^{b} \pm 0.02$	$6.44^{c} \pm 1.53$
σ^2_{EC}[2]	$0.125^{a} \pm 0.004$	$0.217^{b} \pm 0.008$	$0.758^{c} \pm 0.013$

[a,b,c]Means or variances in the same row with different subscripts differ significantly ($P < 0.001$).

[1]X_{20} = Average of the 20 highest electrical conductivity quarter values within milking.

[2]σ^2_{EC} = Variation in electrical conductivity registrations for a quarter within milking.

Figura 8

At cow level, all EC traits were higher for the infected cows compared with healthy cows (9).

Table 2. Distributions of electrical conductivity traits (means ± standard errors) for healthy, subclinically infected, and clinically infected cows.

	Healthy	Subclinical	Clinical
no.	1353	778	340
Max_X_{20}[1]	$5.30^{a} \pm 0.03$	$5.75^{b} \pm 0.04$	$6.73^{c} \pm 0.06$
Max_σ^2_{EC}[2]	$0.242^{a} \pm 0.015$	$0.332^{b} \pm 0.020$	$0.818^{c} \pm 0.030$
IQR_X_{20}[3]	$1.124^{a} \pm 0.004$	$1.182^{b} \pm 0.006$	$1.369^{c} \pm 0.009$
IQR_σ^2_{EC}[4]	$6.85^{a} \pm 0.52$	$7.72^{b} \pm 0.68$	$16.93^{c} \pm 1.03$

[a,b,c]Means in the same row with different subscript differ significantly ($P < 0.001$).

[1]Max_X_{20} = maximum quarter X_{20} value (average of the 20 highest electrical conductivity quarter values within milking) within cow and milking.

[2]Max_σ^2_{EC} = maximum quarter σ^2_{EC} value (the variation in electrical conductivity registrations for a quarter within milking) within cow and milking.

[3]IQR_X_{20} = inter-quarter ratio between maximum and minimum quarter X_{20} value within cow and milking.

[4]IQR_σ^2_{EC} = inter-quarter ratio between the maximum and minimum quarter σ^2_{EC} within cow and milking.

Figura 9

5.2.2. Classification of cows according to health status

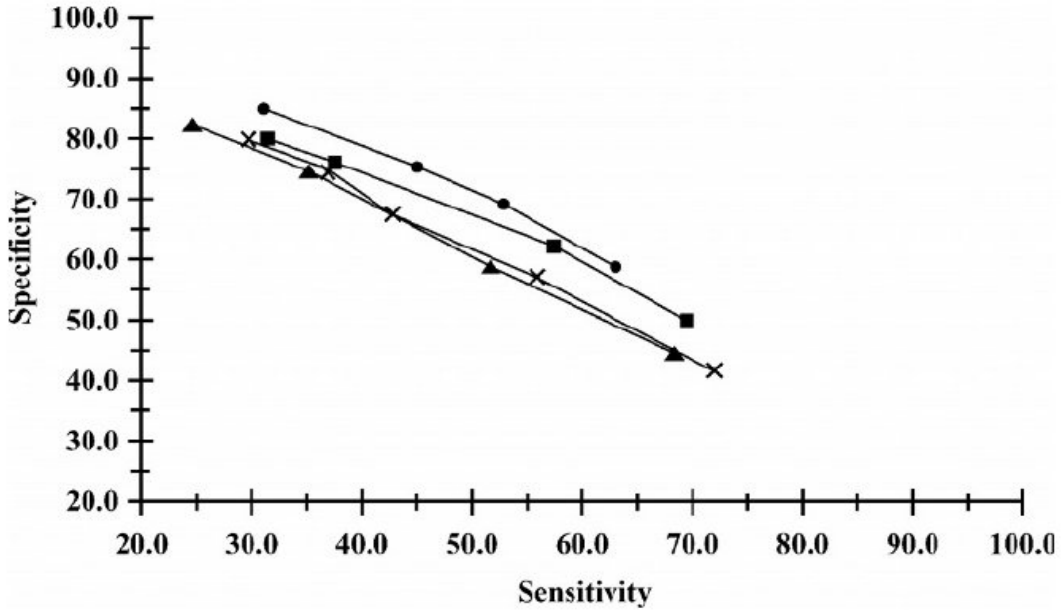

Figure 6. Sensitivities and specificities to separate healthy and subclinically infected cows by using different electrical conductivity traits. Max_X_{20} (■) = highest quarter X_{20} (average of the 20 highest electrical conductivity quarter values within milking) value, Max_σ^2_{EC} (×) = highest quarter σ^2_{EC} (the variation in electrical conductivity registrations for a quarter within milking) value, IQR_X_{20} (●) = inter-quarter ratio between highest and lowest quarter X_{20} value, and IQR_σ^2_{EC} (▲) = inter-quarter ratio between the highest and lowest quarter σ^2_{EC} values. All values are given within cow and milking.

Figura 10

Results from the discriminant function analyses are given in 11.

Table 3. Sensitivities and specificities for separation of healthy and infected cows by use of different EC traits; calculated for Subset 1 (healthy and clinically infected cows), Subset 2 (healthy and subclinically infected cows), Subset 3 (healthy and clinically + subclinically infected cows), and the full data set (healthy, clinically infected, and subclinically infected cows).

	Subset 1		Subset 2		Subset 3		Full data set		
EC trait[1]	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity clinical	Sensitivity subclinical	Specificity
Max_X_{20}	17.9	91.5	15.8	91.5	41.8	79.8	30.6	1.9	93.6
Max_σ^2_{EC}	16.2	98.0	2.8	98.0	21.0	91.7	17.4	0	97.4
IQR_X_{20}	46.2	92.3	15.9	92.3	41.4	85.5	45.0	1.9	94.3
IQR_σ^2_{EC}	32.1	97.0	3.6	97.0	34.7	79.6	18.5	0	96.2
Combination	47.9	91.9	19.4	91.9	44.8	84.6	43.5	7.8	92.9

[1]Max_X_{20} = maximum quarter X_{20} value (average of the 20 highest electrical conductivity quarter values within milking) within cow and milking, Max_σ^2_{EC} = maximum quarter σ^2_{EC} value (the variation in electrical conductivity registrations for a quarter within milking) within cow and milking, IQR_X_{20} = inter-quarter ratio between maximum and minimum quarter X_{20} value within cow and milking, and IQR_σ^2_{EC} = inter-quarter ratio between the maximum and minimum quarter σ^2_{EC} within cow and milking. Combination is combination of all 4 electrical conductivity traits.

Figura 11

6. [5]

6.1. Results

6.1.1. Level I: Sensor technique

- CE((15)
- CE y milk colour sensors (7)
- Biosensor para detectar enzimas haptoglobine, L-lactate (5)
- SCC sensor (2)

6.1.2. System quality

The reported sensitivities ranged from 55 per cent to 89 per cent, while reported specificities ranged from 56 per cent to 99 per cent. For the sensor systems studied, a trade-off exists between sensitivity and specificity as high sensitivity (¿80vice versa. None of the studies reported a combination of high sensitivity and high specificity. Moreover, none of the studies met the **ISO/FDIS 20966 limit of 80 per cent sensitivity with 99 per cent specificity**.

For EC, in combination with milk colour sensors, good performance has been reported (84.6 per cent sensitivity and 99.4 per cent specificity) [1], with treated CM cases as a gold standard.

The Herd Navigator® (DeLaval, Tumba, Sweden), which automatically takes and analyses milk samples, seems to perform good (80–82 per cent sensitivity and 98 per cent specificity) [2,3], although this is only based on two non- peer-reviewed studies published in conference proceedings and the used gold standard is unclear.

Referencias

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[5] C.J. Rutten, A.G.J. Velthuis, W. Steeneveld and H. Hogeveen, "*CAN SENSOR TECHNOLOGY BENEFIT MASTITIS CONTROL*".

[1] Song X, van der Tol R. Automatic Detection of Clinical Mastitis in Astronaut A3TM Milking Robot; 2010; Toronto, Canada. pp. 154-155.

[2] Mazeris F. DeLaval Herd Navigator(R) Proactive Herd Management; 2010; Toronto, Canada. pp. 26-27.

[3] .Vreeburg N. Precision Management On Two Dutch Dairy Farms By Use of Herd Navigator (R); 2010; Toronto, Canada. pp. 104-105.