Lameness detection using force plates and artificial intelligence

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Lameness scoring is a routine procedure in dairy industry for screening the herd for new lameness cases. Subjective lameness scoring which is the most popular lameness detection and screening method in dairy herds has some limitations such as low intra-observer and between-observer repeatability and the discrete nature of scores that limits its usage in monitoring the treatment protocol. The aim of this study is to develop an automated lameness scoring system comparable to conventional subjective lameness scoring using artificial neural networks. The system is composed of 4 balanced force plates installed in a hoof trimming box. A group of 105 dairy cows used for the study. Twenty three features extracted from ground reaction force (GRF) data are used in computer training process which is performed on 60% of the data. The remaining 40% of data is used to test the trained system. Repeatability of the lameness scoring system was determined by GRF samples of 25 cows which were captured in 2 different times in the same cow. The mean standard deviation was 0.31 and the mean coefficient of variation was 14.55% which represents a high repeatability in comparison with subjective vision based scoring methods. Although highest sensitivity and specificity values were seen in score 1 and score 4 the automatic lameness system is both sensitive and specific in all groups. The sensitivity and specificity is more than 72% in score 1 to 4.

Evaluation of sole ulcer cure rate

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Sole Ulcer is a noninfectious disease that causes severe cow lameness and milk reduction. Because this lesion is heel horn erosion, the treatment time is long. This current study was done during a 9 month period in a dairy cow with 2000 milking cows. Data of sole ulcers were recorded at first visit and each month after the first visit and the ulcer revealed treated when a layer of horny tissue covered the hole of the ulcer. Treatment was done by removing the horny tissue around the ulcer, using a wooden block on its contra sound digit. Also locomotion of the cows scored on a five point scale monthly. Total of 69 ulcers recorded, as 57 (82.6%) cases were in rear feet. Total of treated lesions in three consequent month and also the number of culled cows were recorded in table 1.

<table>
<thead>
<tr>
<th>Follow up month</th>
<th>Number of treated/ Percent</th>
<th>Number of culled/ Percent</th>
<th>Days to final treatment</th>
<th>Uncured ulcers</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>29/ 42.02</td>
<td>7/ 10.14</td>
<td>25.03 ± 8.8</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>23/ 33.33</td>
<td>1/ 1.44</td>
<td>68.67 ± 14.09</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>5/ 7.34</td>
<td></td>
<td>106.27 ±28.15</td>
<td>4/ 5.9</td>
</tr>
</tbody>
</table>

The average treatment time for sole ulcers recorded as 50.13 ± 28.94 days that ranged from 20 to 164 days, 5.79% of the cows that still got uncovered ulcers remained in the herd three month after treatment and total of 11.59% of the cows were culled during this period. Locomotion scores of the cows increased from three month before (2.68 ± 1.04), reach to the highest amount one month before (3.64±1.37), and decrease again till three month after recording the lesion (2.76 ± 1.23)(P<0.05).The average days in milk of affected cows was 250 days and treatments were more successful in cows with days in milk 300 and higher (P<0.05). Long course of locomotion scores (around 6 month) showed that locomotion scores were increased before clinically start of the condition and continue after its clinically treatment of it.

Evaluation of white line disease cure rate

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White line disease (WLD) is one of the most important diseases among cow's lameness causes. This current study was done during a nine month period in a dairy herd with 2000 milking cows. Hoof trimming and inspections were done in a regular basis by expert trained hoof trimmers. Gait of the cows scored by a five point scoring system on a monthly basis. When a WLD were recorded, each month after recording the lesion visited by a veterinarian and the lesion revealed treated when a layer of new horny tissue covered the white line area. Treatment was done by removing the horny tissue around the lesion and elevating affected digit by using a wooden block on its contra sound digit. Total of 38 WLD were recorded, as 19 (50%) in front feet and 19 (50%) in rear feet. The average treatment time was recorded as 33.54 ± 18.86 days that ranged from 20 to 106 days. Seventy three (73.68%) percent of cows detected as treated at the first month after treatment,