**Automatic classification of measures of lying to assess the lameness of broilers**

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**Abstract**

Leg disorders are a major cause of poor welfare in broilers. Previous studies have shown that at slaughter age at least 90% of chickens experienced some degree of gait problems and approximately 30% were seriously lame. In this study, a new and non-invasive technique was developed to automatically assess the lameness of the birds. For this purpose, video surveillance images of broilers with five different pre-defined gait scores were recorded as they walked along a test corridor. Afterwards, the image-processing algorithm was applied to detect the number of lying events (NOL) and latency to lie down (LTL) of broiler chickens. Then, the results of the algorithm were compared with visually assessed manual labelling data (reference method) and the relation between these measures and lameness was investigated. Eighty-three percent of NOL were correctly classified by the automatic monitoring system when compared to manual labelling using a data set collected from 250 broiler chickens. The results also showed a positive significant correlation between NOL and gait score and a significant negative correlation between LTL and gait-score level of broilers. Since strong correlations were found, on the one hand, between two measures and gait-score level of broiler chickens and, on the other, between the results of algorithm and manual labelling, the results suggest this automatic monitoring system may have the potential to be used as a tool for assessing lameness of broiler chickens.

**Keywords**: animal welfare, automatic monitoring, broiler chickens, gait score, lameness, latency to lie

**Introduction**

The broiler chicken industry has grown steadily over the last 50 years. Genetic selection and developments in feed and management of broiler chickens have resulted in improved efficiency of broiler meat production. At the same time, public concerns with regard to the welfare of these animals have grown as well (McKay et al 2000). The most important questions relating to broiler welfare raised in the last two decades are the increasing susceptibility to metabolic and locomotory problems due to fast growth rates and inactivity of the chickens (Bauer et al 1996; Bessei 2006). Lameness is a broad term which describes a range of injuries to broiler chickens of both infective and non-infective origin (Thorp & Duff 1988; Swayne & Halvorson 2003). Skeletal disorders in broiler chickens are responsible for significant losses (Cook 2000). In some houses it has been observed that at a mean age of 40 days, over 27.6% of birds showed poor locomotion and 3.3% were almost unable to walk (Knowles et al 2008). In the USA in 1998, the cost of these skeletal disorders was estimated to be between 80 and 120 million dollars per year (Bradshaw et al 2002). The occurrence of lameness is thought to be strongly correlated with weight and growth rate (Vestergaard & Sanotra 1999). Accelerated growth rates and heavier bodyweights were stated to have an influence on locomotion (Kestin et al 2001). A heavy bodyweight requires more from the partially grown skeletal system and leads to abnormal ‘gait scores’ (Corr et al 2003). Moreover, locomotory problems may be painful to the animal and decrease their mobility while increasing secondary problems, such as hock burns and chest soiling (Weeks et al 2000). The latency to lie down test (LTL), for assessing the severity of lameness in broiler chickens was described by Weeks et al (2002) as the length of time that birds remained standing in shallow water. It was measured and results compared with the results of conventional gait scoring. A highly significant ($P < 0.001$) relationship was seen between the LTL and birds’ gait scores (Kestin et al 1992; Weeks et al 2002). As the original testing procedure, in which the birds are tested in groups, involves a settling-in period, which makes the test too time-consuming to perform on commercial broiler farms, a new test was designed by Berg and Sanotra (2003) to record the LTL. The main difference or advantage of this new test was that the birds were tested individually without visual contact with other birds.