A Novel Machine Learning Model for Estrous Cycle Classification

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The estrous cycle regulates reproductive events and hormone changes in female mammals and is akin to the menstrual cycle in humans. Monitoring the cycle is necessary as it is a biomarker for overall health and is crucial for interpreting study results. The estrous cycle comprises four stages influenced by fluctuating levels of hormones. Tracking the cycle relies on vaginal cytology, which categorizes stages based on three epithelial cell concentrations. However, this method has limitations, including time-consuming training and variable accuracy among researchers. To address these challenges, this study utilized an object detection machine learning model, to identify cell types during the estrous cycle in mice. A dataset of 555 cytology images with four different stains was annotated by drawing bounding boxes with labels around each cell. An accurate set of rules for classification that hadn't previously existed was derived by analyzing training images. The model achieved an average accuracy of 87% in classifying cycle stages, taking only 3.9 minutes to analyze 175 images, compared to unsupervised models(36% accuracy) and human accuracy(84% accuracy). These findings facilitate the integration of the estrous cycle into research, enhancing the quality of scientific results by allowing for the identification of estrous cycle-related sex differences and refining research practices in female studies. Moreover, the results suggest that object detection can extend beyond cycle monitoring to accurately classify cell types and cytology images, with implications for cancer detection and histopathological analysis. Applying object detection to these fields promises faster and more accurate outcomes, standardizing procedures and enhancing diagnostic precision in patient care.

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