Shining a light on chicken embryo health can reduce costs, prevent spread of disease

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Checking on bird embryos might just have gotten easier. A research team from Daegu Gyeongbuk Institute of Science and Technology (DGIST), South Korea, have demonstrated a new way of monitoring the blood flow of bird embryos still in their eggs, which could provide poultry farmers with a relatively simple and cheap technique to track the health of their livestock.

The researchers have published their work in The Optical Society's journal *Biomedical Optics Express*.

"In the poultry industry, early detection as to whether the embryo will survive or not is an important cost saving," said Cheol Song, assistant professor of robotics engineering, DGIST. With early detection, farmers could replace weak and sick embryos with new ones. If the embryos are infected or diseased, early detection can also reduce contamination in the incubation chamber.

Currently, most poultry farmers use a method called candling to ensure their future chicks are developing properly. Typically, during the seventh or eighth day of incubation, they check on the embryo's health by shining the egg with a light in a dark room, revealing the embryo's blood vessels.

But the method has some drawbacks. Before day seven it can't easily or accurately monitor the embryo's health. It's also not that effective during later stages of incubation – as the embryo develops, it grows organs and

muscles that block the view. Farmers are also unable to use candling to measure important vital signs like blood flow, making it difficult to determine whether an embryo will survive.

Other more sophisticated techniques are invasive, complex, expensive, or don't work for an entire incubation period, approximately 21 days.

Researchers have explored a new method called diffuse speckle contrast analysis (DSCA). The technique was recently developed to measure blood flow in tissues, and particularly in microcirculation – the flow through the tiniest vessels in the body. For example, Song said, the method is being commercialized for diagnosing "diabetic foot," in which diabetes can cause damage to the feet's blood vessels. This is the first time DSCA been applied to bird embryos.

When a laser beam shines through tissue, the light scatters and creates splotches of dark and light called a speckle pattern. It turns out that if the pattern is moving – like in flowing blood – it's blurry with low contrast. But if the tissue moves slowly or is stationary, then you would get a high-contrast image of the pattern. By analyzing the contrast of the light, which penetrates deep in the tissue, researchers can calculate the relative speeds of the blood flow. Because blood transports nutrients and oxygen, its flow is a direct indicator of an embryo's metabolism, development and health.

The researchers' experiments showed that their method accurately revealed blood flow, measuring how the rate increases every day as the embryo develops in its shell. They were able to monitor the embryo's vital signs for the entire incubation period. And when the researchers placed an egg in the refrigerator – to simulate stressful conditions – they measured a more sluggish flow rate, showing that the method can distinguish a healthy embryo from a weakened one.

Implementing the technique is also straightforward, Song said, and could be commercialized within a few years. "In the near future, this method can help in the automated inspection of chick embryos," he said. If researchers develop an automatic algorithm to detect and monitor blood flow, then they can build a robotic system to examine the eggs.

More information: Chaebeom Yeo et al. Avian embryo monitoring during incubation using multi-channel diffuse speckle contrast analysis, *Biomedical Optics Express* (2015). DOI: 10.1364/BOE.7.000093

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