

Explainable Carnegie Staging of the Human Embryo using Artificial Intelligence

Research Line: Applied Medical Image Analysis
Project type: Master Project
Approx. duration: 6 to 9 months



Project description: The Carnegie staging system provides a standardized framework for assessing both normal and abnormal morphological development during the embryonic period. The Carnegie stages define 23 distinct steps that chronologically outline embryonic development from conception to the start of the fetal stage, indicating that all major organ systems are formed. Examples of these stages are illustrated in Figure 1. We have developed a deep learning model that can accurately predict the Carnegie stage of an embryo, given a 3D ultrasound image [1]. Currently, the model gives no insight into which features were used to determine the stage. The aim of this project is to explore explainable deep learning methods or design novel features that explicitly assess developmental features such as neck curvature, limb position and brain ventricles in order to bring more insight into the models decision making.

Project ideal for: Are you a technical student with programming experience (preferably Python) who: is interested in medical image analysis and early human development, wants to learn more about deep learning and feature engineering and is eager to apply learned algorithms in the field of prenatal image analysis? ***A visit to the clinic is part of this project.***

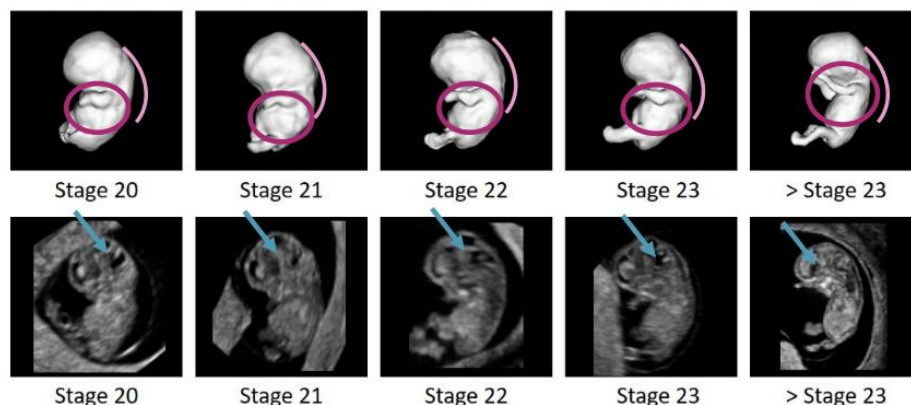


Figure 1. Examples of stages 20 – 23 and >23 showing the fetal stage. Top row shows 3D rendering highlighting limb and neck differences. Bottom row shows 2D slices highlighting brain development.

[1] Niemantsverdriet, R., Bastiaansen, W., Vos, F., Steegers-Theunissen, R. P., Klein, S., & Rousian, M. (2024). Artificial intelligence for automated Carnegie staging of the human embryo in three-dimensional ultrasound: The Rotterdam periconception cohort. *Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology*, 64(S1), 61-62



Interested in this project?

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