# Development and Validation of a Convolutional Neural Network for the Automatic Detection of Multiple Gastric Lesions in Multi-brand Capsule Endoscopy Videos: A Pilot Study

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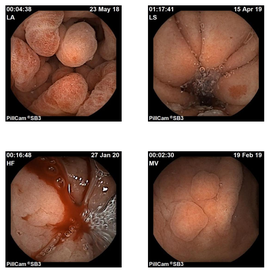
## Introduction

**Capsule endoscopy** (CE) is the **goldstandard** for the evaluation of the **small bowel.**



However, during the video analysis, various **lesions of the upper digestive tract can be seen** and reported.




To date, performance of artificial intelligence (AI) based algorithms for detection of gastric lesions in CE images has not been evaluated.

**We aimed to develop and test a CNN-based algorithm for automatic detection of multiple gastric lesions (Vascular and Protruding lesions; Hematic residues and Ulcers/ Erosions of the gastric mucosa).**

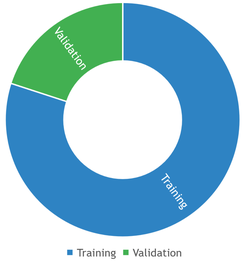
## Methods and Materials

We used a total of **12873 CE images**, from **three different CE types** (PillCam® Crohn's; PillCam® SB3; OMOM® HD capsule endoscopy system):

| | Images |
|---|---|
| Total | 12873 |
| Protruding lesions | 1407 |
| Ulcers/ Erosions | 994 |
| Vascular Lesions | 840 |
| Hematic Residues | 2851 |
| Normal mucosa | 6781 |

**Table 1.** Images per Category.

A **training dataset** comprising **80%** of the images was defined. Subsequently, we evaluated the performance of the network using an independent **test dataset** (**20%** of total image pool).




The **output was compared to a consensus classification** provided by two endoscopists experienced in CE. The performance of the network was measured using the **sensitivity, specificity, accuracy, positive predictive and negative predictive values (PPV and NPV, respectively), and area under the curve (AUC).**

## Results

After optimization of the neural architecture, our model presented the following metrics:

| | |
|---|---|
| Sensitivity | 98.4% |
| Specificity | 97.9% |
| Positive Predictive Value | 97.8% |
| Negative Predictive Value | 98.5% |
| Overall accuracy | 98.1% |
| AUROC | 1.00 |

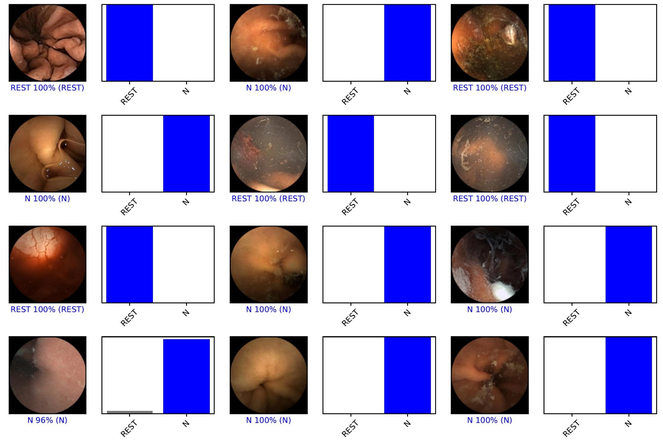



**Figure 1.** Output obtained after CNN application

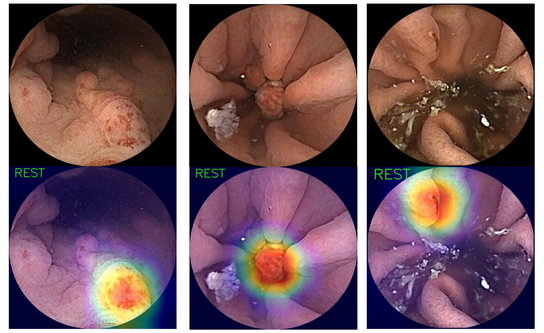



**Figure 2.** Heatmaps allowing lesion detection

## Discussion

To the best of our knowledge this is the **first model** ever developed for the **automatic detection of multiple gastric lesions** in multi-brand CE videos. This type of automated algorithms may enhance CE ability for exploring upper gastrointestinal disease.

**Work main strengths:**

- Pioneer CNN capable of detecting multiple lesions in gastric mucosa;
- Trained and validated in multi-brand images;
- Outstanding performance metrics.

**Limitations**:

- Retrospective study;
- Used still frames instead of full CCE videos;
- No clinical validation study developed;

## Contact

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