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Machine-learning based clinical plaque detection using a synthetic plaque lesion model for coronary CTA

SPIE Medical Imaging 2021 Paper Number: 11597-99

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Involved Partners

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University Heart and Vascular Center Hamburg

Institute of Medical Technology and Intelligent Systems

Digital Imaging and Medical X-Ray Systems

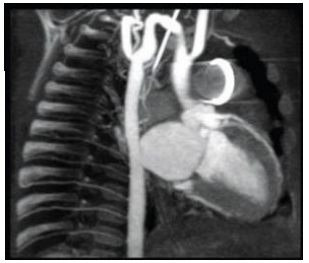
Scope

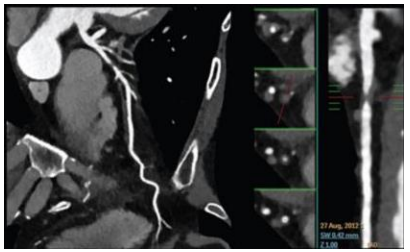
- Coronary computed tomography angiography (**coronary CTA**) is an important diagnostic tool in the assessment of **coronary artery disease** (CAD).

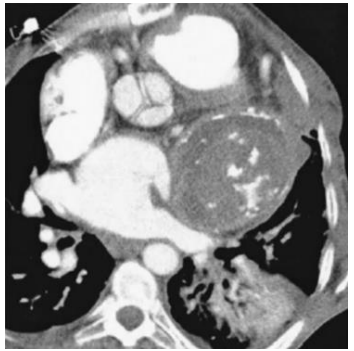
- **Data-driven** predictive systems rely on high-quality ground truth data **in large abundance.**

- We propose a **synthetic forward model** to generate plaque lesions for coronary CTA.

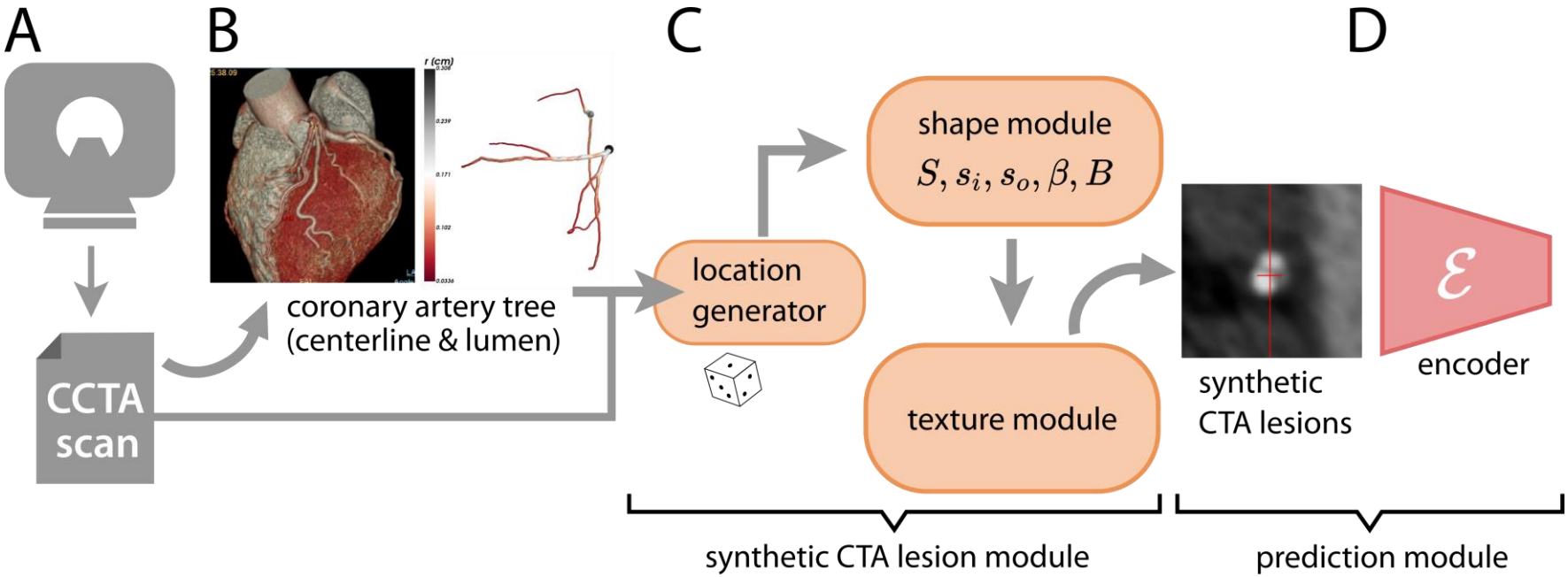
- This helps to **ease the annotation burden** for CTA machine learning applications.





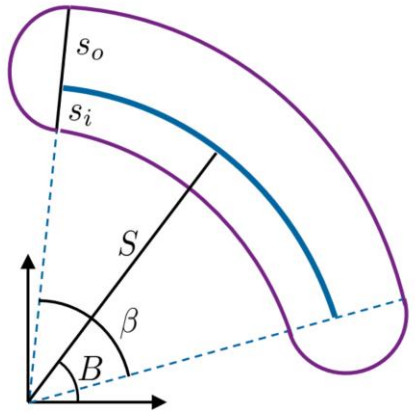


Overview


A
B
C
D
CCTA scan
coronary artery tree (centerline & lumen)
location generator
shape module
S, s_i, s_o, β, B
texture module
synthetic CTA lesions
$\mathcal{E}$
encoder
synthetic CTA lesion module
prediction module

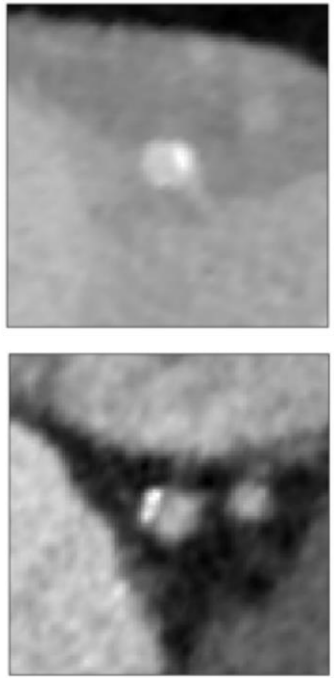
Synthetic lesion model

A

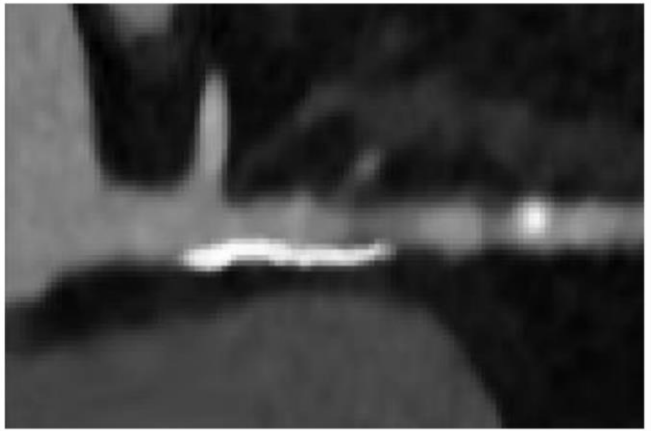


Major radius	S
Inner minor radius	s_i
Outer minor radius	s_o
Opening angle	β
Orientation angle	B

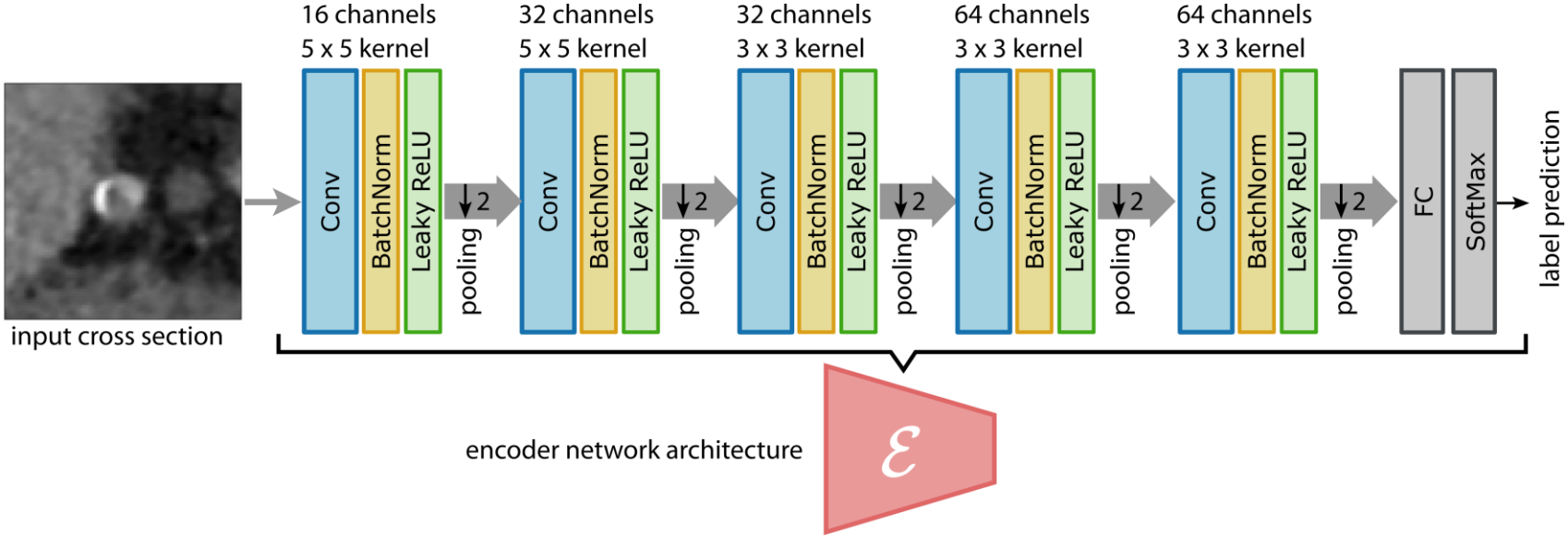
B



C



Learning framework

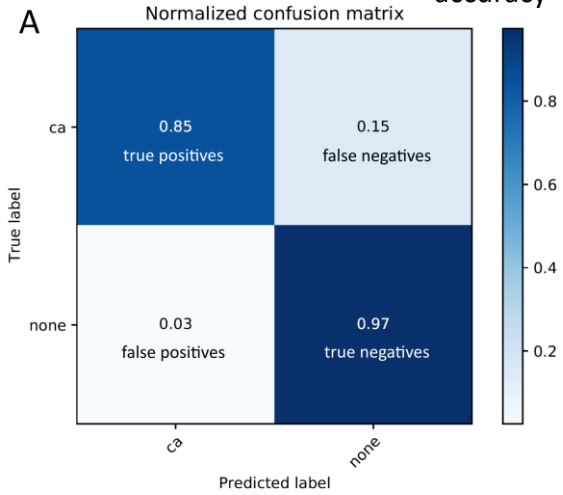


- We perform various **plaque detection** experiments (binary classification) on a per-cross section basis.

Results

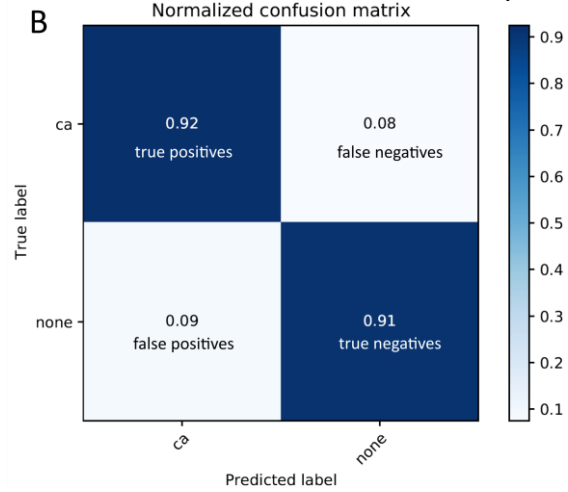
Clinical baseline experiment

accuracy = 91%

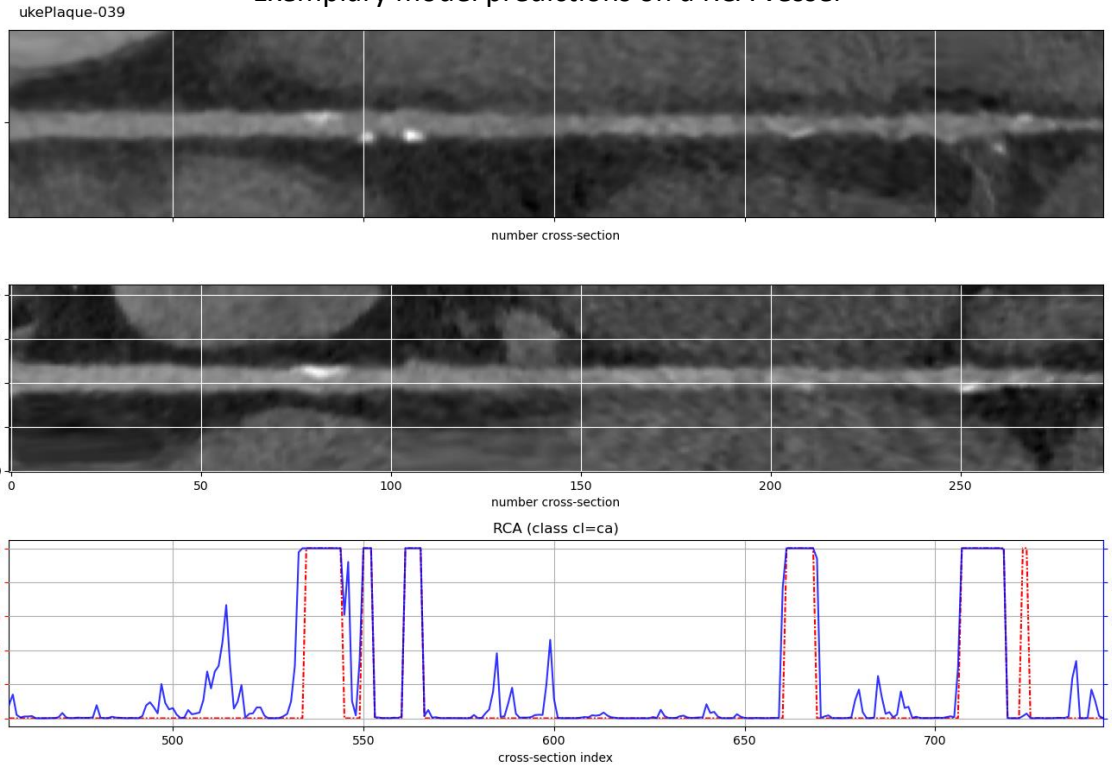


with synthetic pre-training

accuracy = 92%



Exemplary model predictions on a RCA vessel



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Thank you for your attention.

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