Inclusive Artificial Intelligence for Medical Imaging in Low-Resource Settings

Karim Lekadir
University of Barcelona
Barcelona Artificial Intelligence in Medicine Lab
(BCN-AIM)

Part 1 – AFRICAI:

African Network for AI in Biomedical Imaging

MICCAI

Medical Image Computing &
Computer Assisted Intervention
International Society (Since 1998)

Annual meetings

Workshops

Tutorials

Challenges

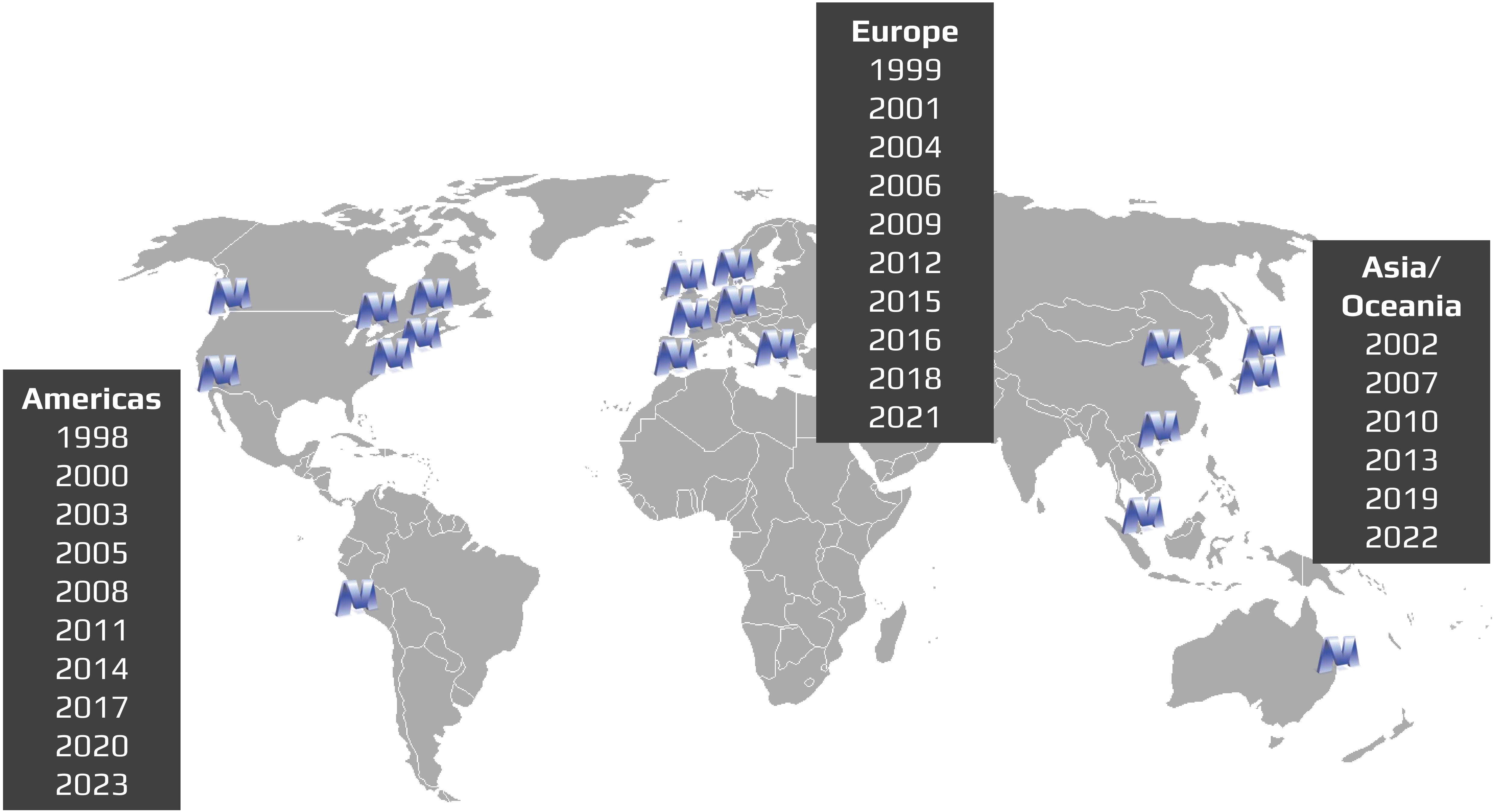
Mentorships

Publications

MICCAI


MICCAI2022
Singapore
25th International Conference on Medical Image
Computing and Computer Assisted Intervention
September 18–22, 2022
Resorts World Convention Centre Singapore


MICCAI2023
Vancouver
CANADA
26th International Conference on Medical Image
Computing and Computer Assisted Intervention
October 8-12, 2023 - Vancouver/CANADA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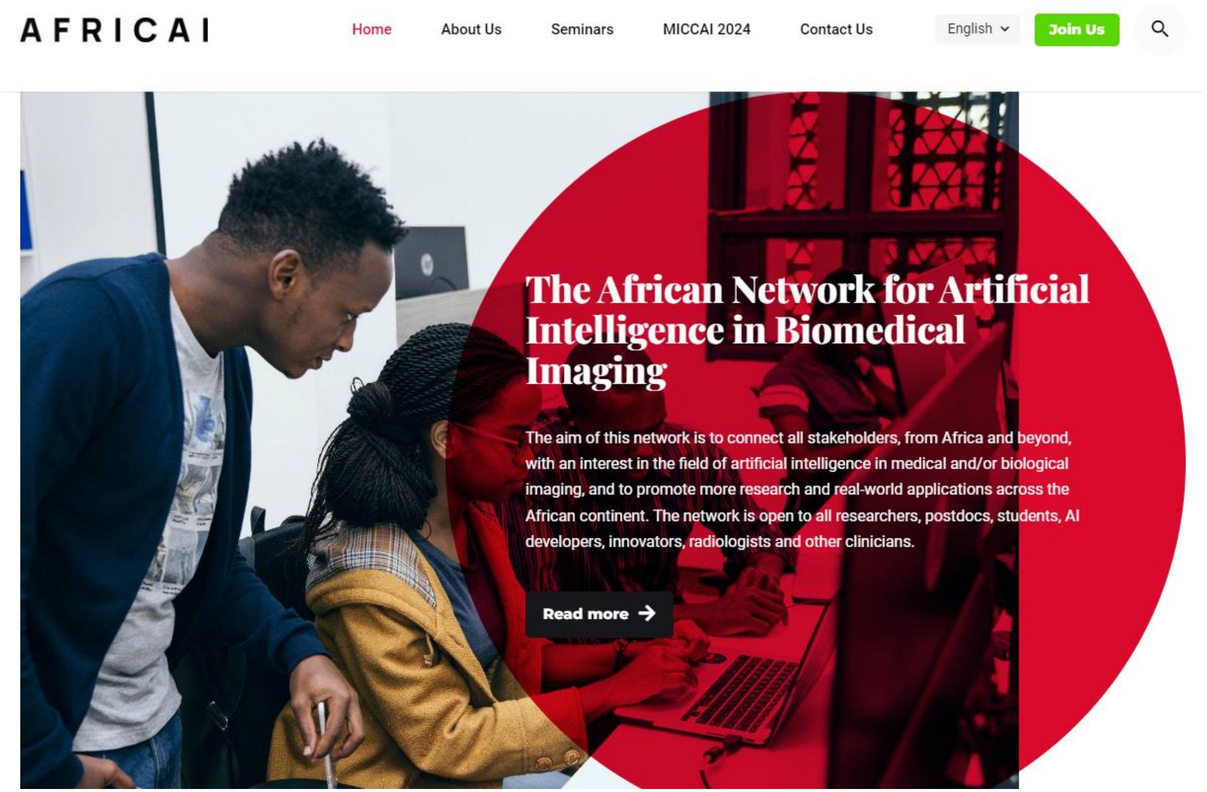
MICCAI 2024

And the location of MICCAI 2024 is...

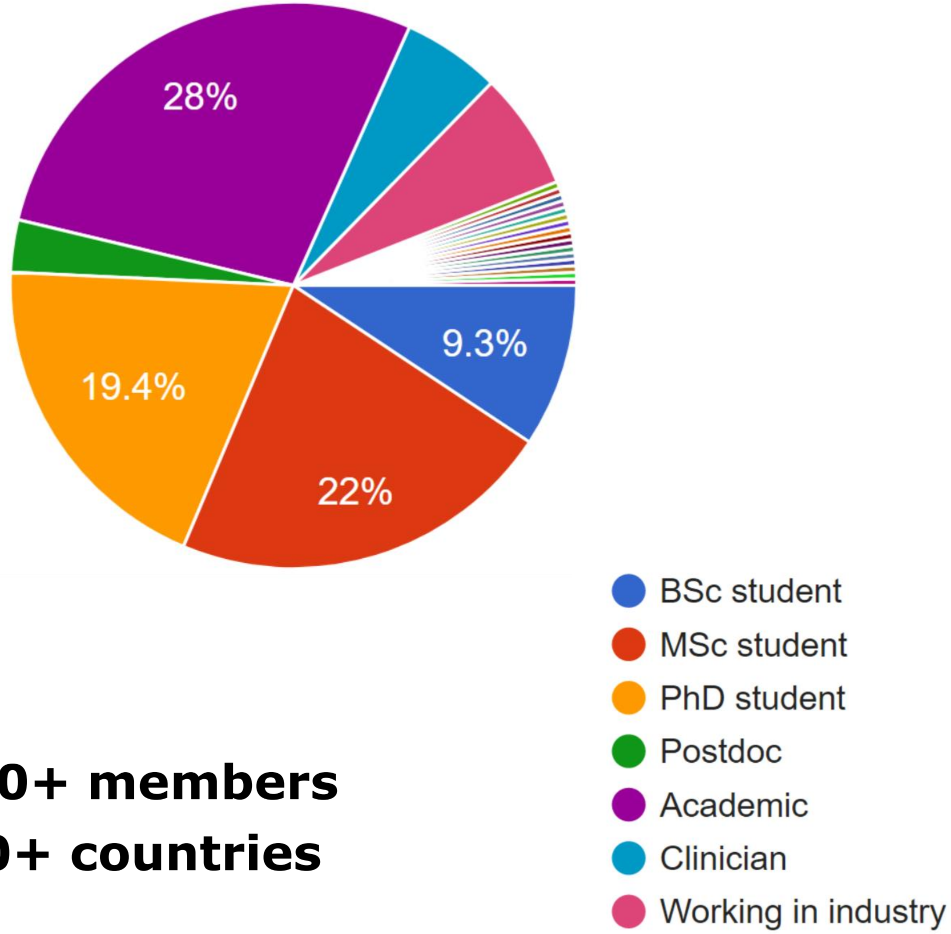
Thursday 31st December 2020

We are delighted to announce that the 27th MICCAI conference in 2024 will take place on the African continent for the first time, specifically in the marvellous city of Marrakesh, Morocco.

AFRICAI



www.africai.org



500+ members
30+ countries

EVENTS


RISE-MICCAI + AFRICAI
RISE
AFRICAI
Winter School: AI in Medical Imaging
zoom
November 25th – 27th 2022 16:00 – 19:15 (CET)
Day 1
Dr. Stefan Klein
Erasmus MC, NL
Introduction to AI in medical imaging
Tutorial + Lab Session
Introduction to clinical data, how to create clinical databases and image pre-processing.
Day 2
Dr. Wenjia Bai
Imperial College London, UK
Supervised image segmentation using ML
Tutorial + Lab Session
Introduction to supervised machine learning, image segmentation and medical image segmentation applications.
Day 3
Dr. Miaomiao Zhang
University of Virginia, USA
Supervised image registration using DL
Tutorial + Lab Session
Introduction to supervised deep neural networks, image registration and medical image registration applications.
Register now at
https://bit.ly/3UdHPY8
SCAN ME
The number of virtual spots is limited!
MICCAI
Endorsed event

WEBINARS

4 min read

AFRICAI Seminar | July 20, 2022

3 min read

AFRICAI Seminar | June 22, 2022

3 min read

First AFRICAI Seminar | May 11, 2022

SUMMER SCHOOL

“GET A PAPER READY FOR MICCAI 2024!”

LOCATION: MARRAKESH, MOROCCO

DATE: MAY 8-12, 2023

Goal

MICCAI 2024 will be the first MICCAI conference to be organized on the African continent. The organizing committee wishes to encourage talented young science and engineering Africa-based graduates to submit papers to MICCAI 2024.

The 1 st MICCAI/AFRICAI Summer school will tackle this objective, by offering to 30-40 Africa-based students support to boost their research projects and prepare a submission for the MICCAI 2024 conference.

Contents overview

- Morning sessions of presentation and analysis of accepted MICCAI papers by Senior researchers in the field of MICCAI.
- Afternoon sessions of practical work on the students’ projects with mentors from the MICCAI community.
- Specific sessions to practice the writing of each student’s MICCAI paper.

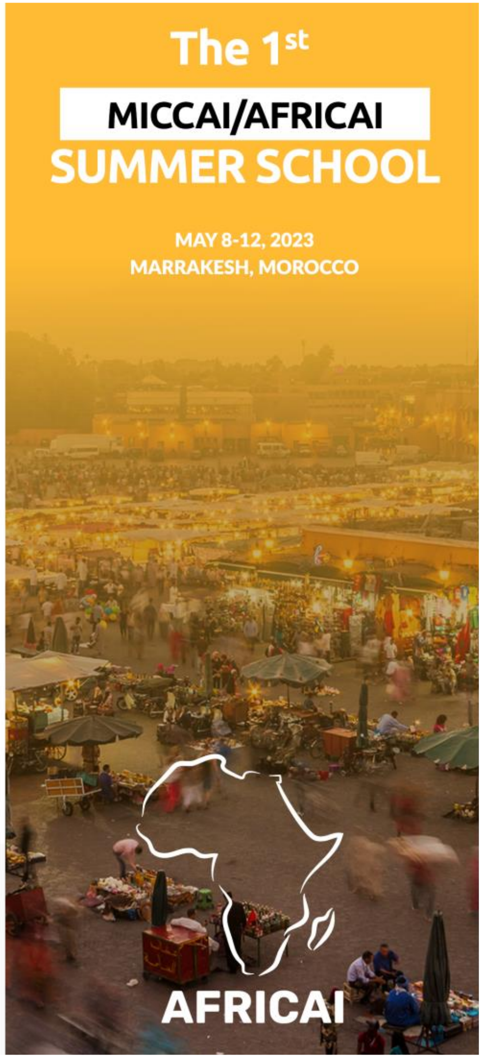
Who can apply?

The summer school is open to all African students (permanently based in an African country), with at least an M.Sc. degree.

Preferably, the student should come with his/her own project and have access to African data, but this is not mandatory.

Program committee

- Yunusa Mohammed Garba, **Gombe State University**
- Nigeria Nassir Navab, **John Hopkins, U.S.A**
- Julia Schabel, **he Technical University of Munich, Germany**
- Sandrine Voros, **Université de Grenoble/TIMC Laboratory INSERM, France**
- Karim Lekadir, **Universitat de Barcelona, Spain**
- Ben Blocker, **Imperial college London, UK**
- Tinashe Mutsvangwa **University of Cape Town, South Africa**
- Jihad Zahir, **Cadi Ayyad University, Marrakesh, Morocco**



Part 2 – AIMIX Project:
Inclusive AI in Medical Imaging

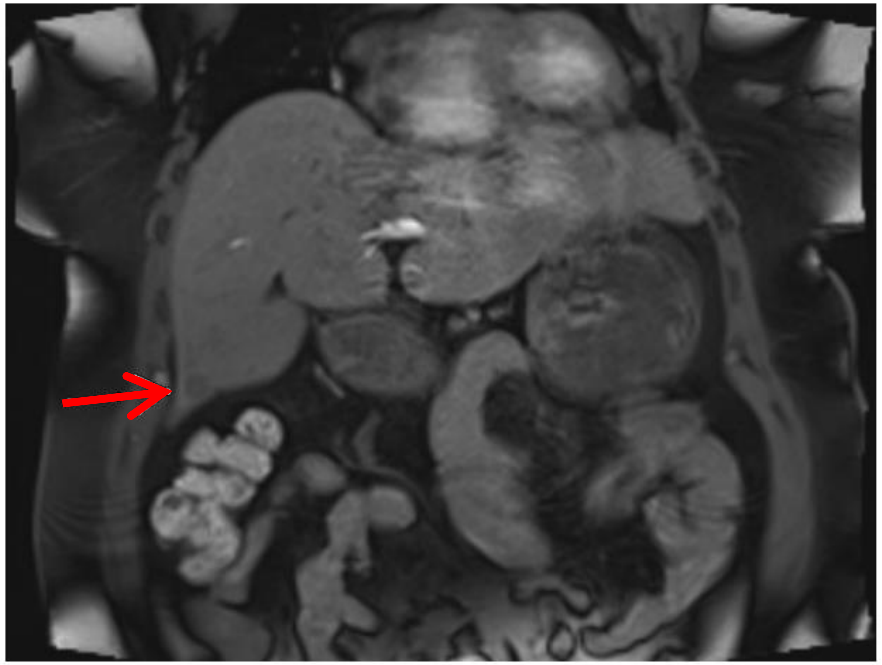
EU PROJECTS

EuCanImage (2022-2024):

A European Cancer Image Platform for Next-Generation Artificial Intelligence and Precision Medicine in Oncology

- Breast cancer
- Colorectal cancer
- Liver cancer

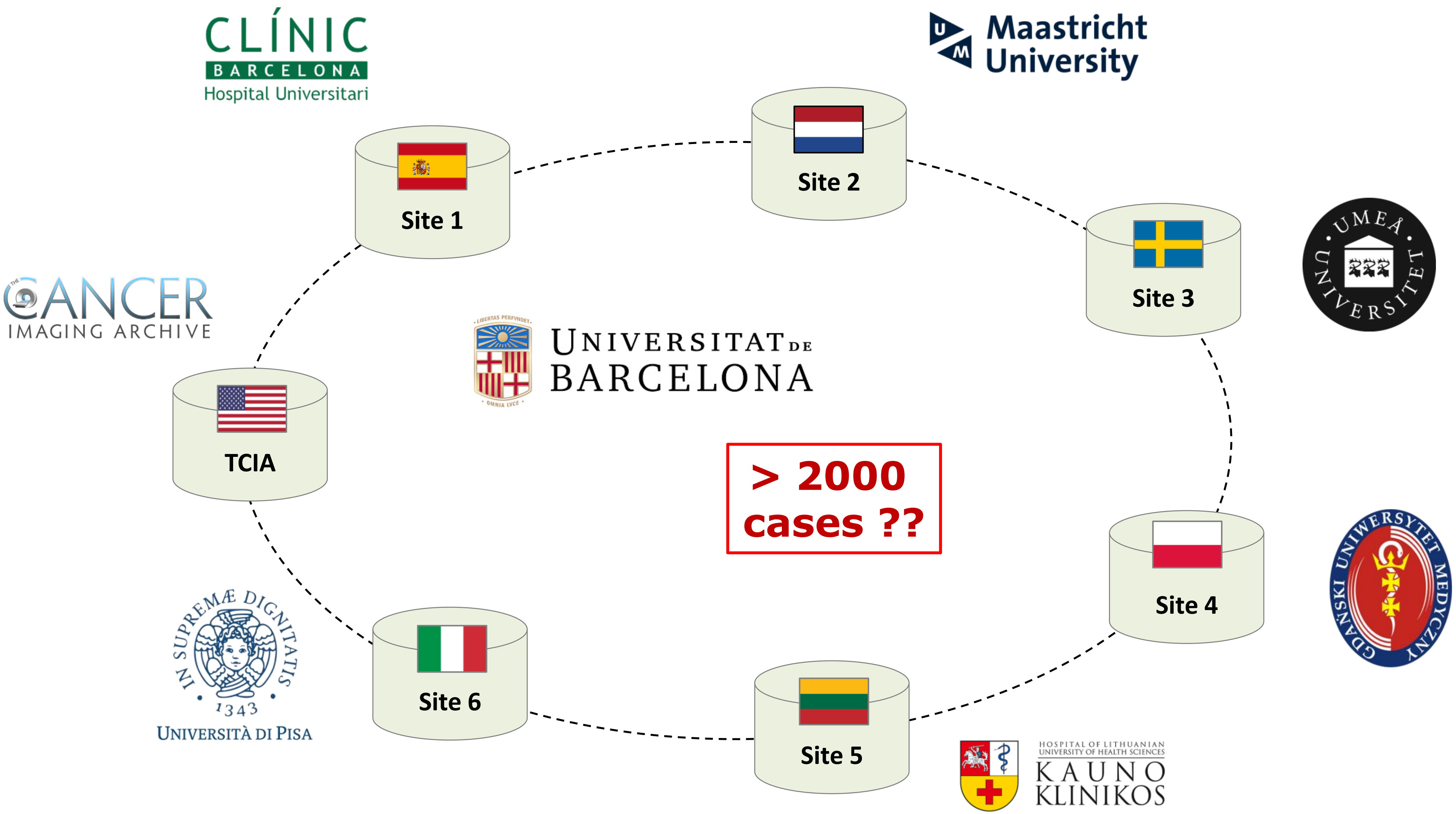
EUCANIMAGE



Can AI increase the diagnostic sensitivity of liver MRI, currently at 60%, for detecting small hepatocellular carcinoma (HCC) lesions ***(≤ 2 cm)*** *in cirrhotic liver?*

Rimola, J. et al. 2012. Non-invasive diagnosis of hepatocellular carcinoma ⩽ 2 cm in cirrhosis. Journal of hepatology, 56(6).

EUCANIMAGE



CLÍNIC
BARCELONA
Hospital Universitari
Maastricht University
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
TCIA
THE CANCER IMAGING ARCHIVE
UNIVERSITAT DE BARCELONA
> 2000 cases ??
UMEÅ UNIVERSITET
GDAŃSKI UNIWERSYTET MEDYCZNY
IN SUPREMÆ DIGNITATIS
1343
UNIVERSITÀ DI PISA
HOSPITAL OF LITHUANIAN UNIVERSITY OF HEALTH SCIENCES
KAUNO KLINIKOS

EU PROJECTS

RadioVal (2022-2026):

International Clinical Validation of Radiomics Artificial Intelligence for Breast Cancer Treatment Planning

- ➢ Trustworthiness
- ➢ FUTURE-AI guidelines

AIMIX PROJECT

How to build AI tools for areas with no "Big Data"?

AIMIX: Collaborative approach

- Combine African and non-African data
- Combine high-end and low-cost data
- Combine general ethical considerations and local contexts

AI FOR MIDWIVES IN RURAL AFRICA

Image:
UN Population Fund
Kenya

PREGNANCY CONDITIONS

e.g. placenta previa or pre-eclampsia risk

AI-POWERED

FETAL ULTRASOUND

REFERRAL TO

COUNTY HOSPITALS

Statistics: UN Population Fund Kenya

APPROACH

	Kenya	Spain	Denmark
Pre-eclampsia	**150** +	**750** +	**32,000**

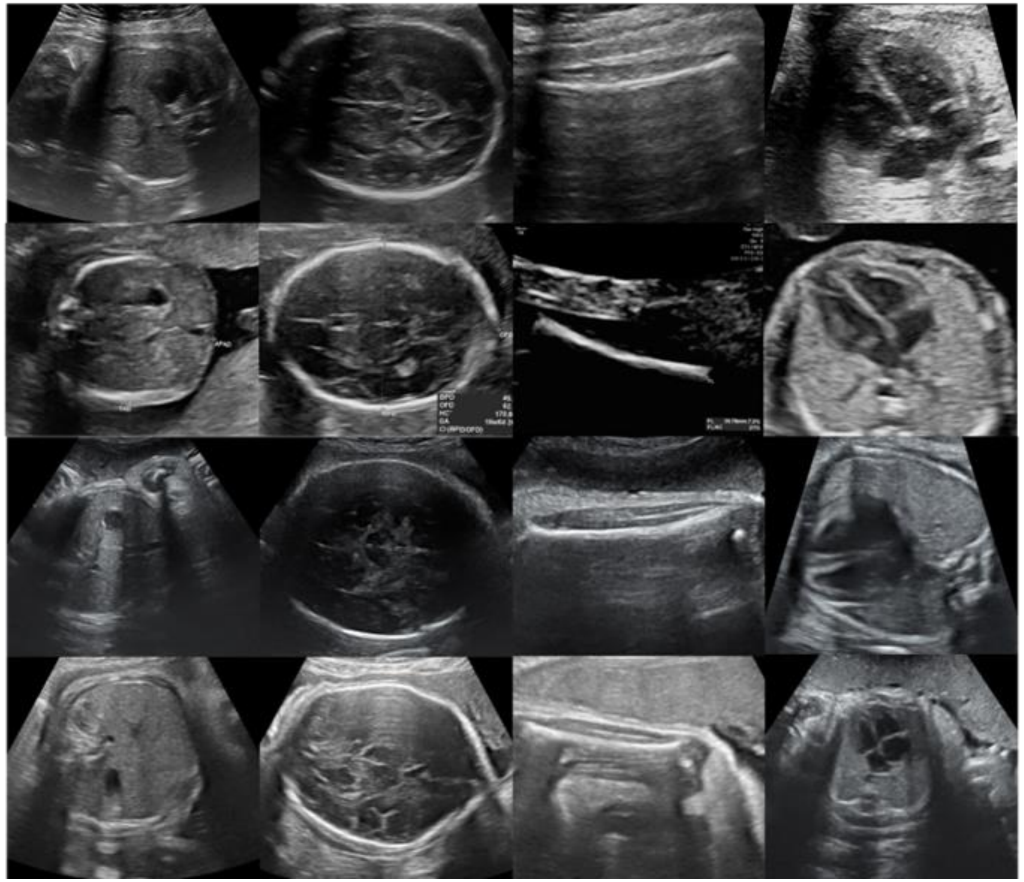
NETWORK “OPTIMISED” FOR LOCAL POPULATION

STEP 1 CROSS POPULATION “SHARED” PATTERNS

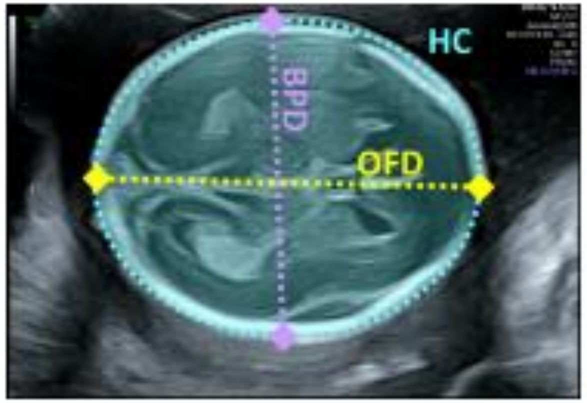
STEP 2 LOCAL POPULATION “SPECIFIC” PATTERNS

PRELIMINARY RESULTS

Abdomen Brain Femur Thorax



Automated plane detection for areas in Africa with limited clinical experts



EXISTING AI

Evaluation of deep convolutional neural networks for automatic classification of common maternal fetal ultrasound planes

Xavier P. Burgos-Artizzu[1,2], David Coronado-Gutiérrez[1,2], Brenda Valenzuela-Alcaraz[1], Elisenda Bonet-Carne[1,3,4], Elisenda Eixarch[1,3,4], Fatima Crispi[1,3,4] & Eduard Gratacós[1,3,4]

The goal of this study was to evaluate the maturity of current Deep Learning classification techniques for their application in a real maternal-fetal clinical environment. A large dataset of routinely acquired maternal-fetal screening ultrasound images (which will be made publicly available) was collected from two different hospitals by several operators and ultrasound machines. All images were manually labeled by an expert maternal fetal clinician. Images were divided into 6 classes: four of the most widely used fetal anatomical planes (Abdomen, Brain, Femur and Thorax), the mother's cervix (widely used for prematurity screening) and a general category to include any other less common image plane. Fetal brain images were further categorized into the 3 most common fetal brain planes (Trans-thalamic, Trans-cerebellum, Trans-ventricular) to judge fine grain categorization performance. The final dataset is comprised of over 12,400 images from 1,792 patients, making it the largest ultrasound datas date. We then evaluated a wide variety of state-of-the-art deep Convolutional Neural Networks dataset and analyzed results in depth, comparing the computational models to research techni which are the ones currently performing the task daily. Results indicate for the first time that computational models have similar performance compared to humans when classifying comm in human fetal examination. However, the dataset leaves the door open on future research to f improve results, especially on fine-grained plane categorization.

Spain

EXISTING AI

SonoNet: Real-Time Detection and Localisation of Fetal Standard Scan Planes in Freehand Ultrasound

Christian F. Baumgartner, Konstantinos Kamnitsas, Jacqueline Matthew, Tara P. Fletcher, Sandra Smith, Lisa M. Koch, Bernhard Kainz and Daniel Rueckert

***Abstract*—Identifying and interpreting fetal standard scan planes during 2D ultrasound mid-pregnancy examinations are highly complex tasks which require years of training. Apart from guiding the probe to the correct location, it can be equally difficult for a non-expert to identify relevant structures within the image. Automatic image processing can provide tools to help experienced as well as inexperienced operators with these tasks. In this paper, we propose a novel method based on convolutional neural networks which can automatically detect 13 fetal standard views in freehand 2D ultrasound data as well as provide a localisation of the fetal structures via a bounding box. An important contribution is that the network learns to localise the target anatomy using weak supervision based on image-level labels only. The network architecture is designed to operate in real-time while providing optimal output for the localisation task. We present results for real-time annotation, retrospective frame retrieval from saved videos, and localisation on a very large and challenging dataset consisting of images and video recordings of full clinical anomaly screenings. We found that the proposed method achieved an average F1-score of 0.798 in a realistic classification experiment modelling real-time detection, and obtained a 90.09% accuracy for retrospective frame retrieval. Moreover, an accuracy of 77.8% was achieved on the localisation task.**

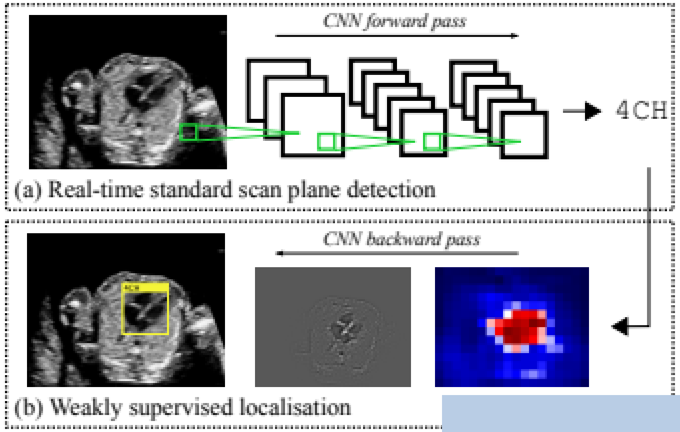


Fig. 1. Overview of proposed SonoNet: (a) 2D f processed in real-time through our proposed conv determine if the current frame contains one of 13 the 4 chamber view (4CH) is shown); (b) if a stan location can be determined through a backward pa

UK

EXISTING AI

GE HEALTHCARE UNVEILS AI-ENABLED ULTRASOUND SYSTEM

Posted by Keri Stephens | Oct 1, 2020 | Ultrasound |

Waukesha, Wis.-based GE Healthcare has unveiled Voluson SWIFT, a U.S. FDA 510(k)-pending ultrasound system designed t
women's health clinicians expand diagnostic capabilities and improve patient outcomes. The system features artificial intelli
(AIP algorithms to support auto recognition in addition to an ergonomic design, advanced image quality, and tools to improv
efficiency.

A recent study found that obstetrics (OB) and gynecology (GYN) clinicians in the United States have some of the highest bur
rates among physicians, with the leading factor being bureaucratic tasks like paperwork, charting, and patient data capture. In today's COVID-19 pandemic environment, these clinicians are now facing additional pressures to see more patients and perform exams quickly to limit possible patient exposure to the coronavirus.

USA

EXISTING AI

Recognition of Fetal Facial Ultrasound Standard Plane Based on Texture Feature Fusion

Xiaoli Wang,[1] Zhonghua Liu,[2,3] Yongzhao Du,[1,3,4] Yong Diao,[1] Peizhong Liu,[1,3,4] Guorong Lv,[3,5] and Haojun Zhang[6]

[1]*College of Medicine, Huaqiao University, Quanzhou 362021, China*
[2]*Department of Ultrasound, Quanzhou First Hospital Affiliated to Fujian Medical University, Quanzhou 362021, China*
[3]*Collaborative Innovation Center for Maternal and Infant Health Service Application Technology, Quanzhou Medical College, Quanzhou 362021, China*
[4]*College of Engineering, Huaqiao University, Quanzhou 362021, China*
[5]*Department of Ultrasound, The Second Affiliated Hospital of Fujian Medical University, Quanzhou 362021, China*
[6]*Biomedical Ultrasound Laboratory, The University of Southern California (USC), Los Angeles, USA*

Correspondence should be addressed to Yong Diao; diaoyong@hqu.edu.cn and Peizhong Liu; pzliu@hqu.edu.cn

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In the process of prenatal ultrasound diagnosis, accurate identification of fetal facial ultrasound standard plane (FFUSP) is essential for accurate facial deformity detection and disease screening, such as cleft lip and palate detection and Down syndrome screening
check. However, the traditional method of obtaining standard planes is manual screening by doctors. Due to differ
doctors, this method often leads to large errors in the results. Therefore, in this study, we propose a texture fe
method (LH-SVM) for automatic recognition and classification of FFUSP. First, extract image's texture features, inc
Binary Pattern (LBP) and Histogram of Oriented Gradient (HOG), then perform feature fusion, and finally ad
Vector Machine (SVM) for predictive classification. In our study, we used fetal facial ultrasound images from 20 to
gestation as experimental data for a total of 943 standard plane images (221 ocular axial planes, 298 median sagitta
nasolabial coronal planes, and 350 nonstandard planes, OAP, MSP, NCP, N-SP). Based on this data set, we perforn
cross-validation. The final test results show that the accuracy rate of the proposed method for FFUSP classificatio
the average precision rate is 94.27%, the average recall rate is 93.88%, and the average *F*1 score is 94.08%. The e
results indicate that the texture feature fusion method can effectively predict and classify FFUSP, which provides an essential basis for clinical research on the automatic detection method of FFUSP.

China

APPLICATION IN AFRICA

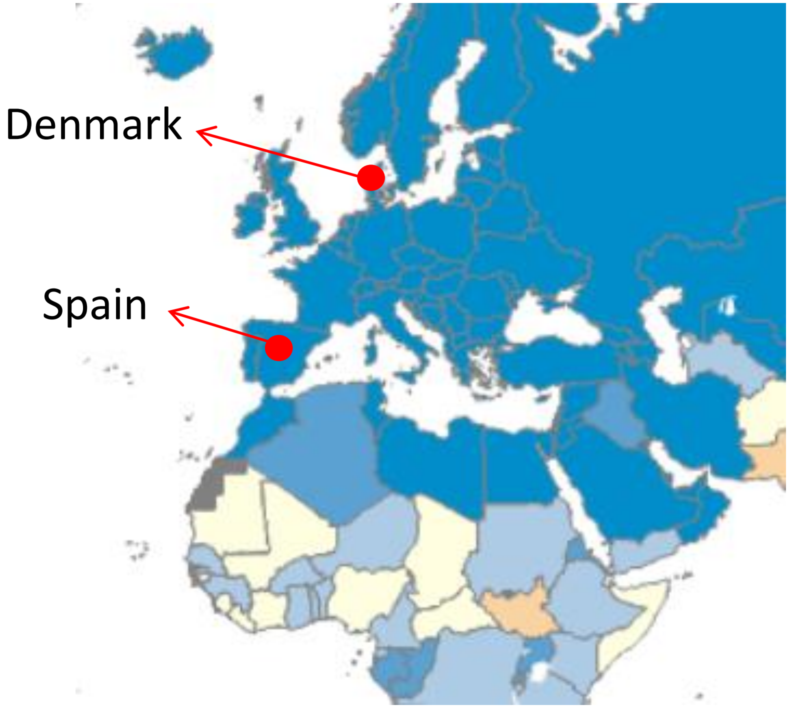
1. Can we **directly** use an existing AI tool for fetal ultrasound plan selection in Africa?

2. Or should we build a **completely new** AI tool with African datasets?

3. Or should we **combine** African and non-African data for building a new tool?

EUROPEAN DATASETS

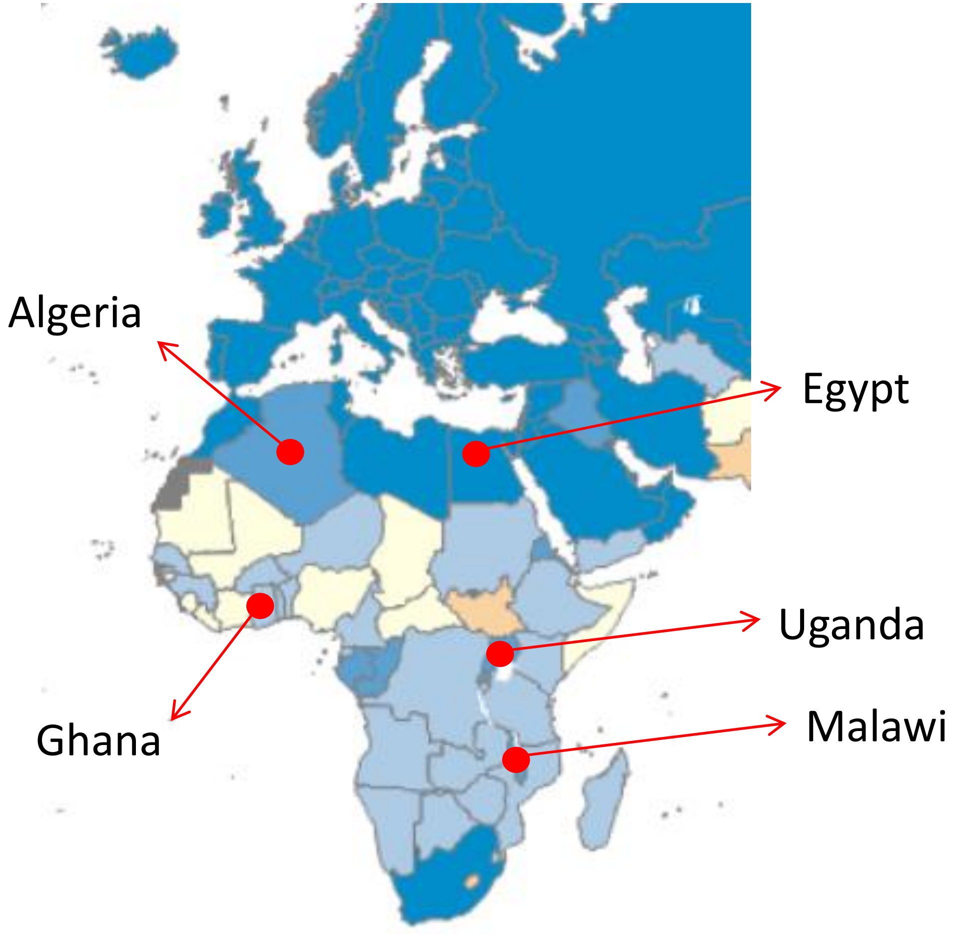
Collection of a multi-country and multi-centre **(n=2)** maternal-fetal US dataset labelled with the most common US fetal planes: **femur, head, abdomen** and **thorax** and **other.**



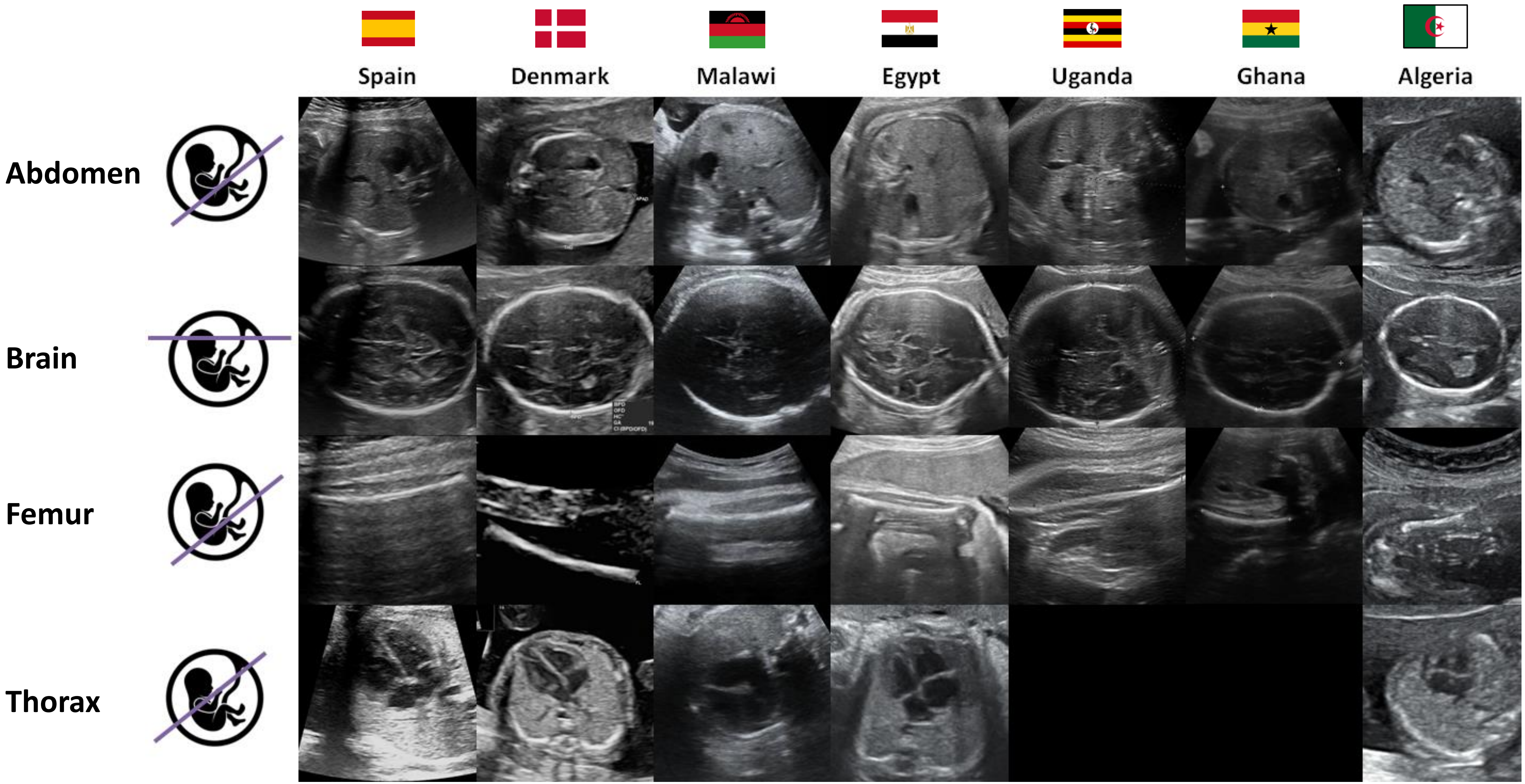
X. P. Burgos-Artizzu, D. et al. Evaluation of deep convolutional neural networks for automatic classification of common maternal fetal ultrasound planes, Scientific Reports 10 (1) (2020)
M. Tolsgaard et al. Does artificial intelligence for classifying ultrasound imaging generalize between different populations and contexts?, Ultrasound in Obstetrics and Gynecology. 12

AFRICAN DATASETS

Collection of a multi-country and multi-centre **(n=5)** maternal-fetal US dataset labelled with the most common US fetal planes: **femur, head, abdomen** and **thorax** and **other.**



IMAGES



Spain
Denmark
Malawi
Egypt
Uganda
Ghana
Algeria
Abdomen
Brain
Femur
Thorax

SAMPLE SIZE

Country	Abdomen	Brain	Femur	Thorax	Other	TOTAL
Spain	711	3092	1040	1718	4213	12400
Denmark	771	635	844	291	0	2541
Malawi	25	25	25	25	0	100
Egypt	25	25	25	25	0	100
Uganda	25	25	25	0	0	75
Ghana	25	25	25	0	0	75
Algeria	25	25	25	25	0	100

DATA PROPERTIES

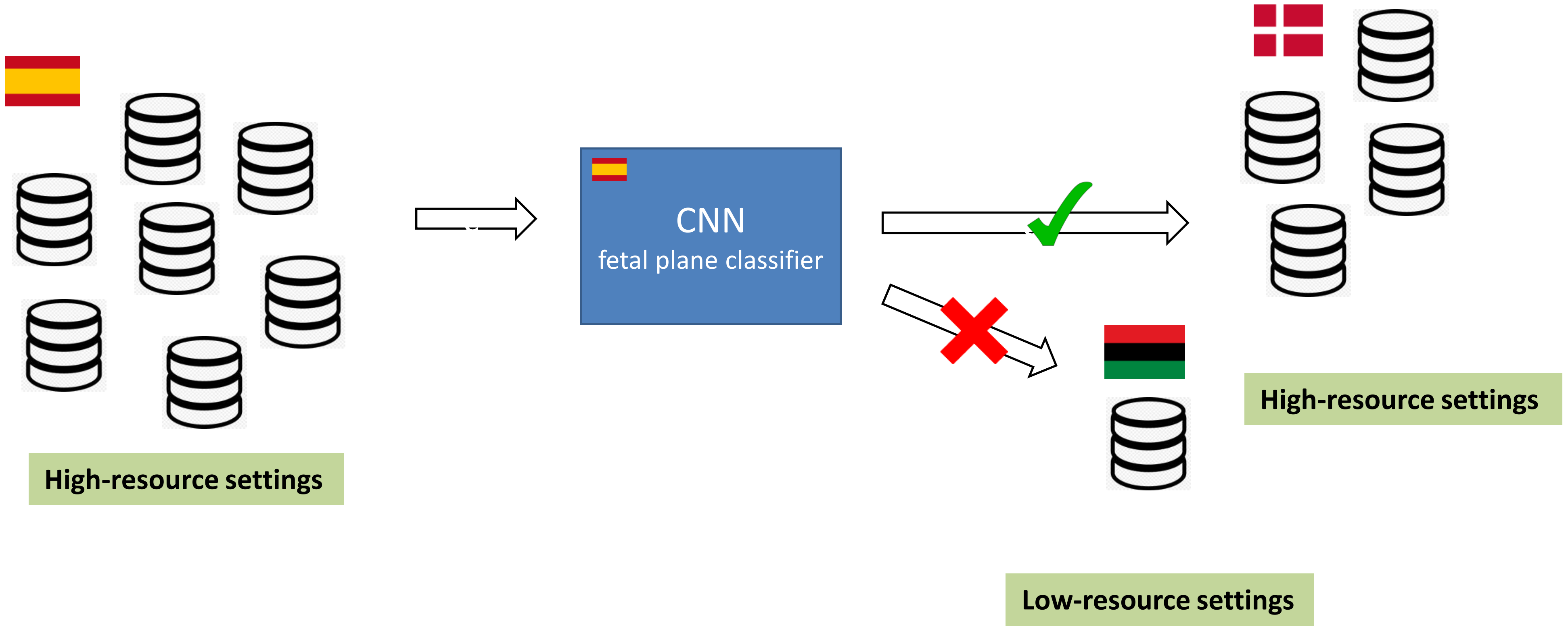
Table 1: Data acquisition details.

Country	Vendors	Type of transducer	Freq range (MHz)	Name of clinical centre	Trimestre pregnancy
Spain	Voluson E6, Voluson S8 and Voluson S10 (GE Medical Systems, Zipf, Austria), and Aloka (Aloka CO., LTD.)	Curved transducer	3 to 7.5	Hospital Clínic and Hospital Sant Joan de Déu	2nd and 3rd
Denmark	Voluson E6, Voluson S8 and Voluson S10 (GE Medical Systems, Zipf, Austria)	Curved transducer	3 to 7.5	Copenhagen University Hospital Rigshospitalet, Hvidovre Hospital, Herlev Hospital and Nordsjællands Hospital Hillerød.	2nd and 3rd
Malawi	Mindray DC-N2 (Shenzhen Mindray Bio-Medical Electronics Co., Ltd, China/Germany)	Curved transducer	3.5	Queen Elizabeth Central Hospital	2nd and 3rd
Egypt	Voluson P8 (GE Medical Systems, Zipf, Austria)	Curved transducer	7	Sayedaty Center	2nd
Uganda	ACUSON X600 (Siemens)	Curved transducer	3 to 7.5	Mulago National Referral Hospital	3rd
Ghana	EDAN DUS 60 (Edan Instruments, Inc., Shenzhen, China)	Curved transducer	3.5 to 5	KBTH Polyclinic (Accra)	2nd and 3rd
Algeria	Voluson S8 (GE Medical Systems, Zipf, Austria)	Curved transducer	3 to 7.5	EPH Kouba and Clinique Des Lilas	2nd and 3rd

European settings

African settings

SPANISH AI MODEL

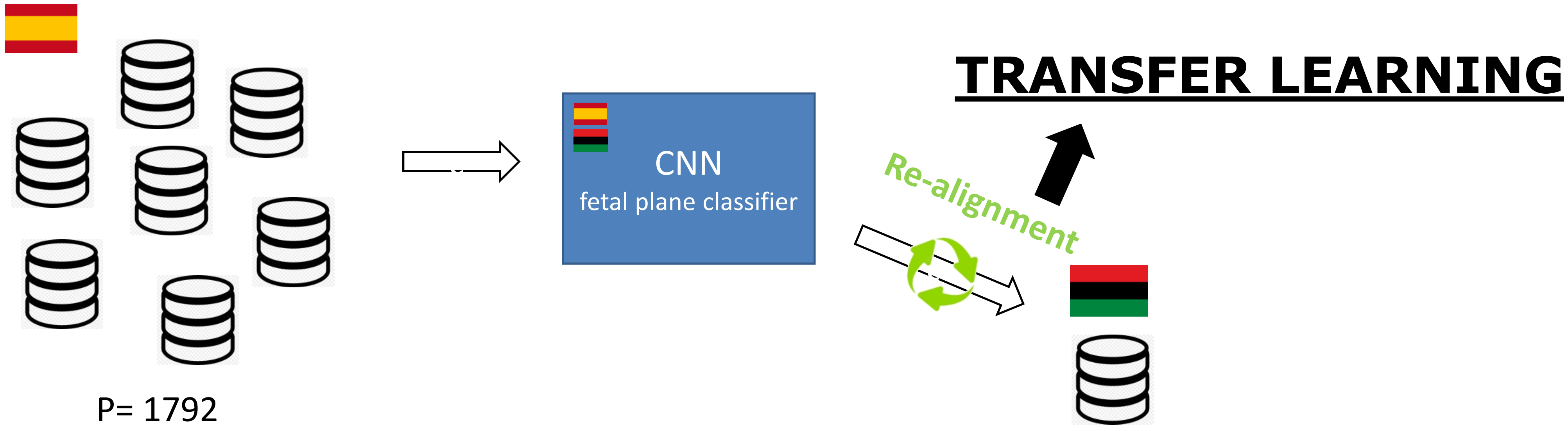


SPANISH AI MODEL

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$$

Country	Average recall (%)
Spain	**93.28**
Denmark	90.32
Malawi	62.18
Egypt	69.23
Uganda	74.36
Ghana	41.02
Algeria	71.15

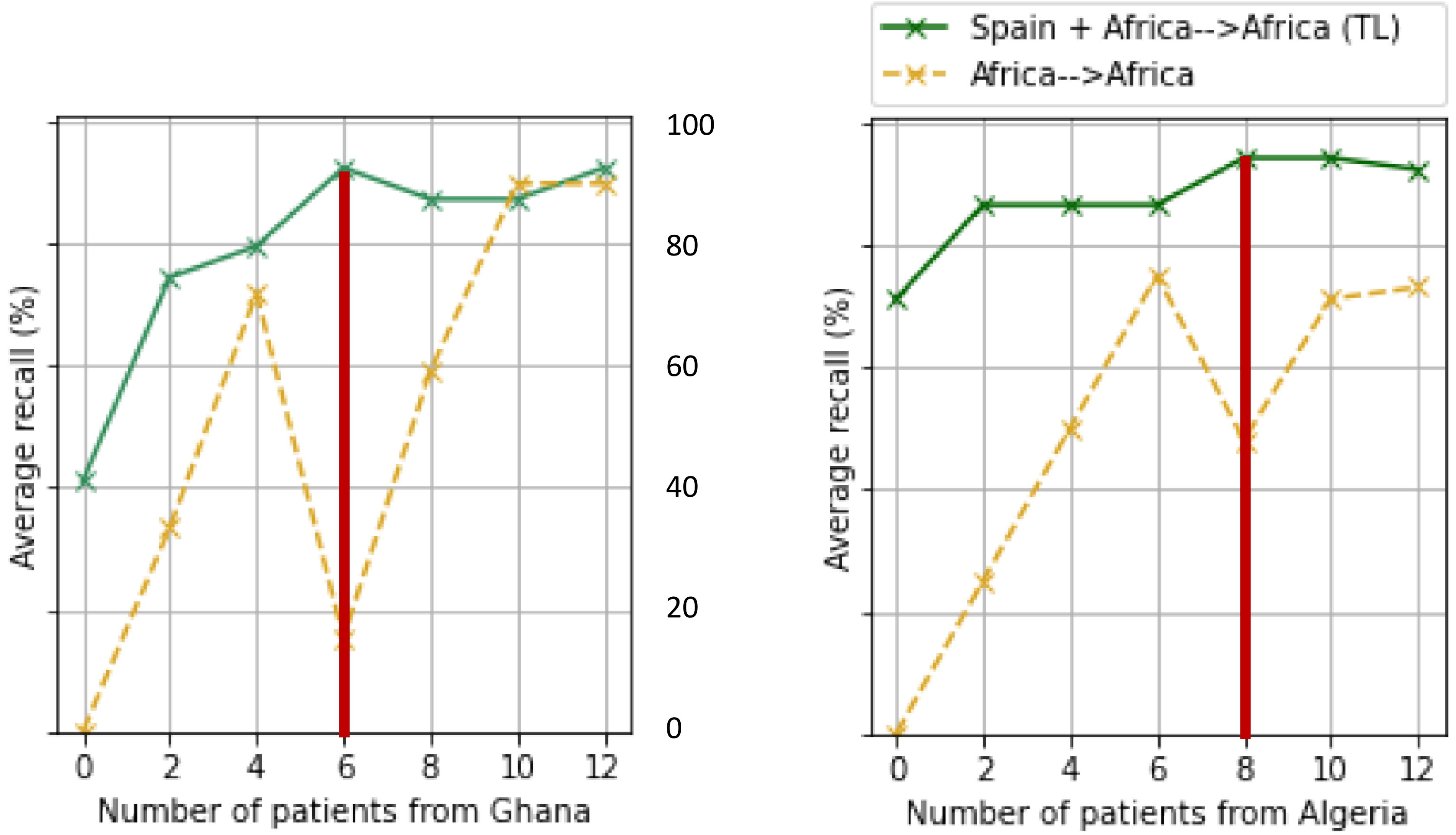
COMBINED AI MODEL



FINAL RESULTS

Country	Average recall (%) BEFORE transfer learning	Average recall (%) AFTER transfer learning
Spain	**93.28**	
Denmark	90.32	
Malawi	62.18	88.30
Egypt	69.23	84.62
Uganda	74.36	100
Ghana	41.02	92.31
Algeria	71.15	92.31

FINAL RESULTS



MANUSCRIPT

Generalisability of deep learning models in low-resource imaging settings: A fetal ultrasound study in 5 African countries

Carla Sendra-Balcells[a], Víctor M. Campello[a], Jordina Torrents-Barrena[b], Yahya Ali Ahmed[c], Mustafa Elattar[d,e], Benard Ohene Botwe[f], Pempho Nyangulu[g], William Stones[g], Mohammed Ammar[h], Lamya Nawal Benamer[i], Harriet Nalubega Kisembo[k], Senai Goitom Sereke[j], Sikolia Z. Wanyonyi[l], Marleen Temmerman[m], Kamil Mikolaj[n], Martin Grønnebæk Tolsgaard[n], Karim Lekadir[a]

[a] *Dept. de Matemàtiques i Informàtica, Universitat de Barcelona, Barcelona, Spain*
[b] *HP Inc., Barcelona, Spain*
[c] *Obstetrics and Gynecology Dept., School of Medicine, Suez University, Egypt*
[d] *Medical Imaging and Image Processing, Center of Informatics Science, Nile University, Egypt*
[e] *Research & Development Division, Intixel, Egypt*
[f] *Dept. of Radiography, School of Biomedical & Allied Health Sciences, College of Health Sciences, University of Ghana, Ghana*
[g] *Kamuzu University of Health Sciences, Blantyre, Malawi*
[h] *Dept. of Electrical Engineering Systems & Laboratory of Engineering System and Telecommunication, University of M'Hamed Bougara Boumerdes, Algiers, Algeria*
[i] *Obstetrics and Gynecology Dept., School of Medicine, Algiers University, Algeria*
[j] *Dept. of Radiology and Radiotherapy, School of Medicine, Makerere University College of Health Sciences, Kampala, Uganda*
[k] *Dept. of Radiology, Mulago National Referral and Teaching Hospital, Kampala, Uganda*
[l] *Dept. of Obstetrics and Gynaecology, Aga Khan University Hospital, 3rd Parklands Avenue, Nairobi, Kenya.*
[m] *UNDP/UNFPA/UNICEF/WHO/The World Bank Special Programme of Research, Development and Research Training in Human Reproduction (HRP), Dept. of Reproductive Health and Research, World Health Organization, Geneva, Switzerland.*
[n] *Copenhagen Academy for Medical Education and Simulation and Dept. of Obstetrics, Rigshospitalet, Denmark*

CONCLUSIONS

- There are challenges for imaging AI development and deployment in low-resource settings
- There are also opportunities to develop smart solutions based on AI that can be realistically implemented in low-resource settings
- Inclusive AI allows to combine data, expertise, resources and disciplines to solve unmet clinical needs using new approaches

Thank You for Your Attention

karim.lekadir@ub.edu

www.africai.org