

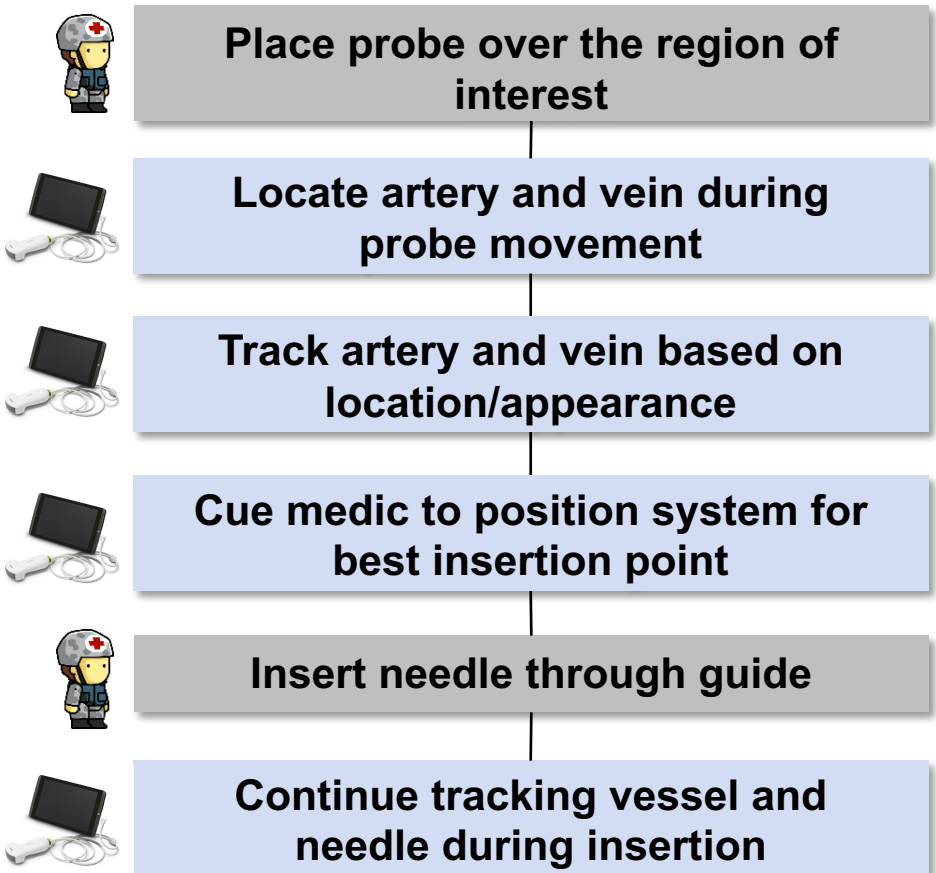
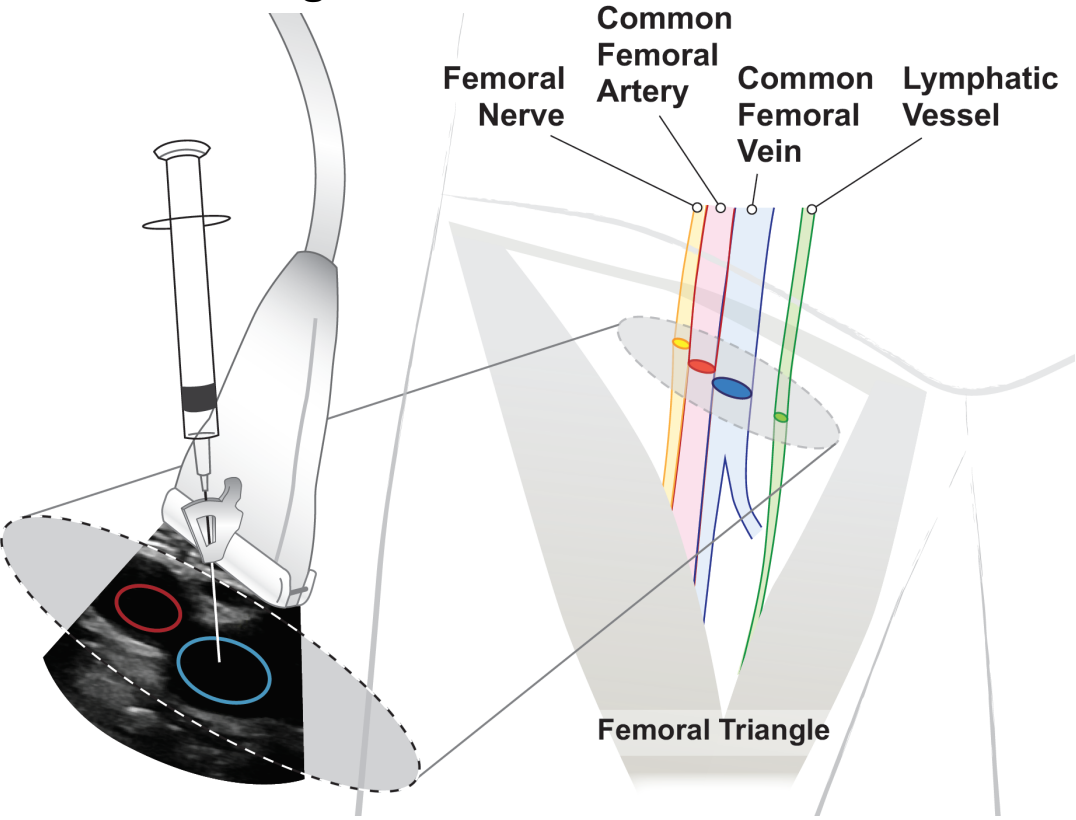
Motivation



- Mass casualties in multi-domain operations will require **prolonged field care**
- Automated life-saving interventions are needed to manage **non-compressible hemorrhage** on the battlefield
- **AI-guided ultrasound** will enable medics to efficiently access the proper **central vein or artery** for catheter placement

System Concept

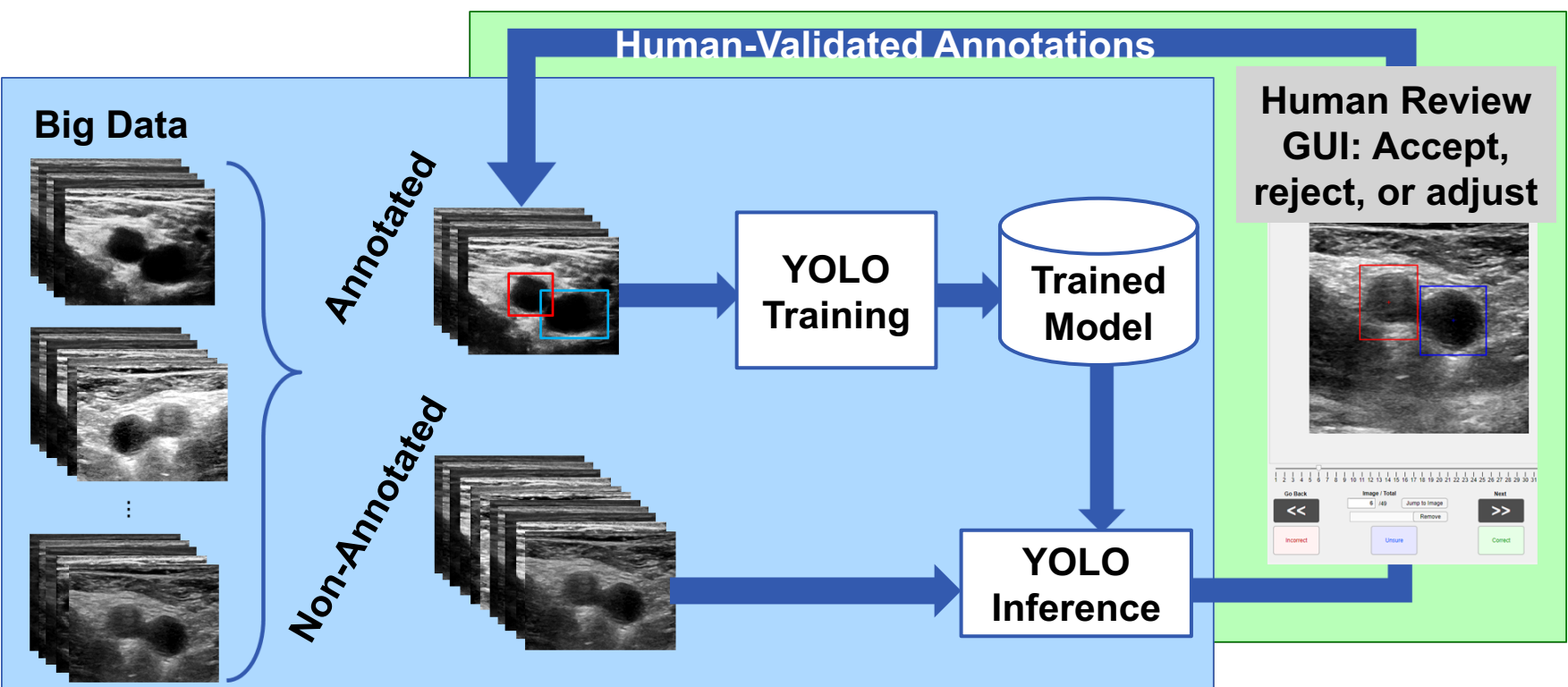
Portable ultrasound with needle guide



AI automates image interpretation and guidance, increasing efficiency for non-specialists

Active Deep Learning-Based Approach

- Adapted “You only look once” (YOLO), real-time detection network^[1]
- Initialized YOLO with ImageNet features, and then applied **transfer learning** by retraining on femoral ultrasound frames to **locate artery and vein***
- **Augmented data** for 10x additional training samples (e.g. image rotation and intensity scaling)
- **Active learning** enables mass generation of semi-automated annotations

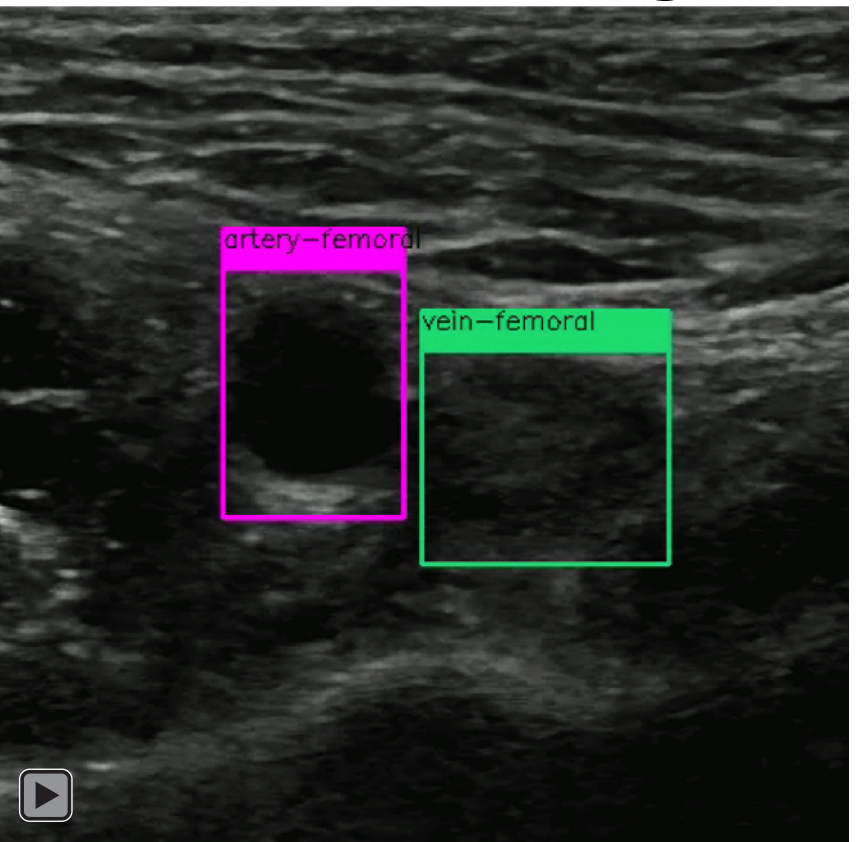


Test Accuracy
99% Recall
96% Precision

YOLO CNN for feature extraction

Type	Filters	Size	Output
Convolutional	32	3 × 3	256 × 256
Convolutional	64	3 × 3 / 2	128 × 128
1x Convolutional	32	1 × 1	
1x Convolutional	64	3 × 3	128 × 128
Residual			128 × 128
Convolutional	128	3 × 3 / 2	64 × 64
2x Convolutional	64	1 × 1	
2x Convolutional	128	3 × 3	64 × 64
Residual			64 × 64
Convolutional	256	3 × 3 / 2	32 × 32
8x Convolutional	128	1 × 1	
8x Convolutional	256	3 × 3	32 × 32
Residual			32 × 32
Convolutional	512	3 × 3 / 2	16 × 16
8x Convolutional	256	1 × 1	
8x Convolutional	512	3 × 3	16 × 16
Residual			16 × 16
Convolutional	1024	3 × 3 / 2	8 × 8
4x Convolutional	512	1 × 1	
4x Convolutional	1024	3 × 3	8 × 8
Residual			8 × 8

Example Detection on Human Images



Real-Time Demo on Phantom

