Electromagnetic Simulation and the Design of Smart Chest Belt for Cardiac Health Monitoring

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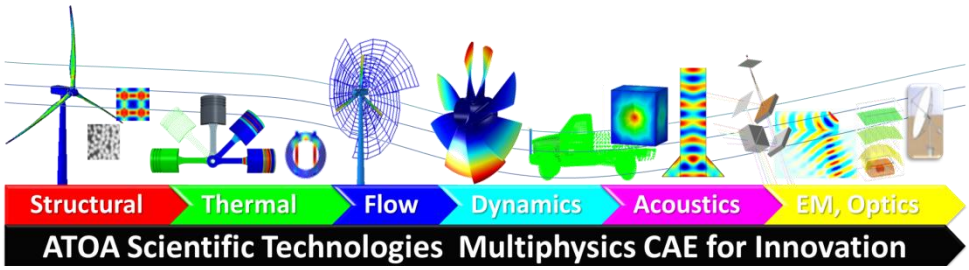

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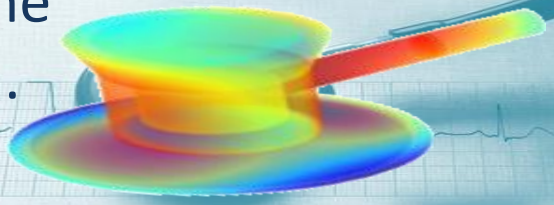
Introduction & Objectives

- In this paper a smart chest belt based electrical potential monitoring technique is explored for error proof and smart monitoring of cardiac electrical signals.

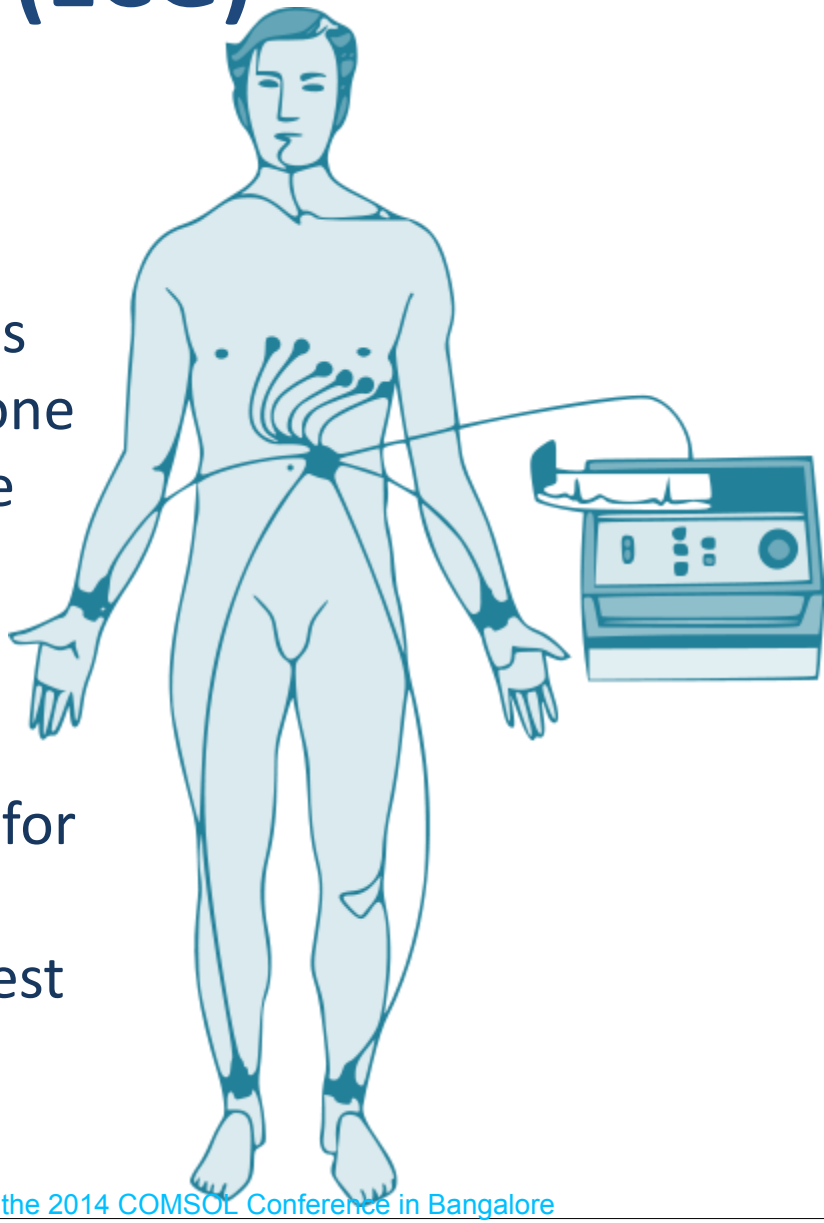
- A smart chest belt is conceptualized for self-sensing and electrical potential mapping of the cardiac electrical signal.



Electro Cardio Graph (ECG)

- Conventional cardiac electrical signal monitoring and measurement techniques such as Electrocardiograph (ECG) are prone to operator error due to multiple lead attachment requirements.

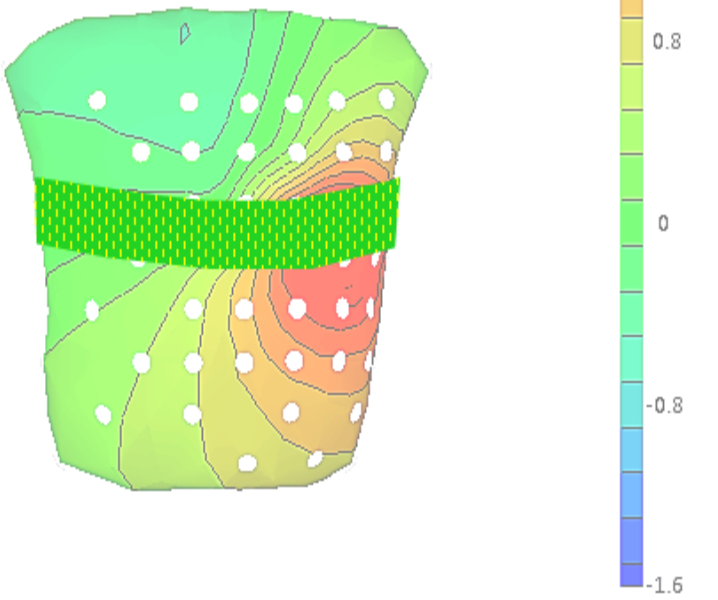
- These multiple electrode based systems are also not convenient for continuous cardiac health monitoring, though ECG is the best way to measure and diagnose abnormal rhythms of the heart.



CHEST BELT CONCEPT

- A smart chest belt embedded with network of sensor is used for mapping the electrical potential. The location, displacement and electrical potential are dynamically monitored and mapped.

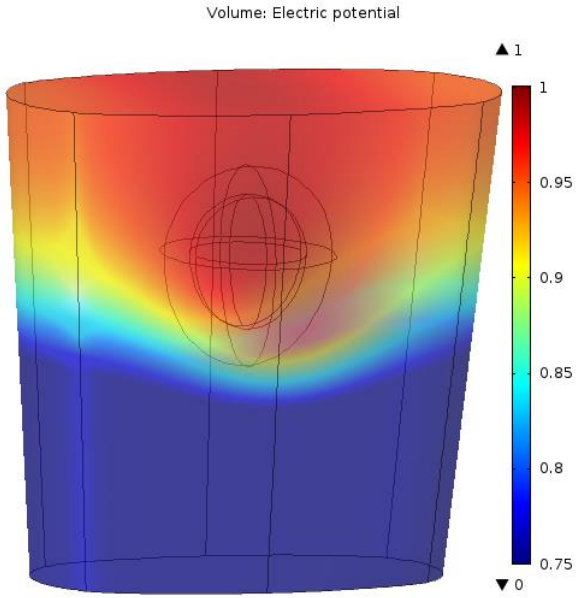
- Typical smart chest belt system and cardio electrical potential distribution contour plots.



Computational methods

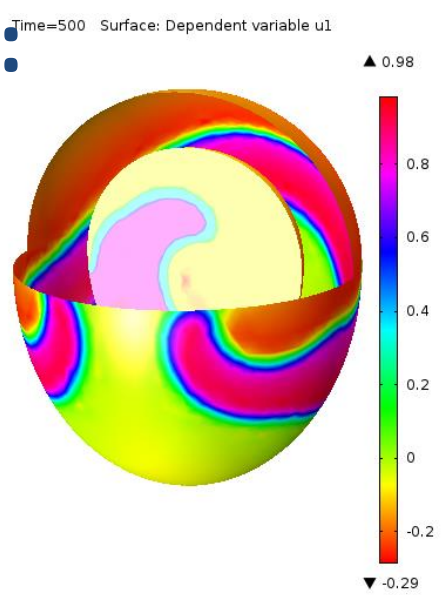
- The COMSOL electromagnetic physics interface is used to model the electrical field distribution on a realistic 3D geometric model of the heart and torso.

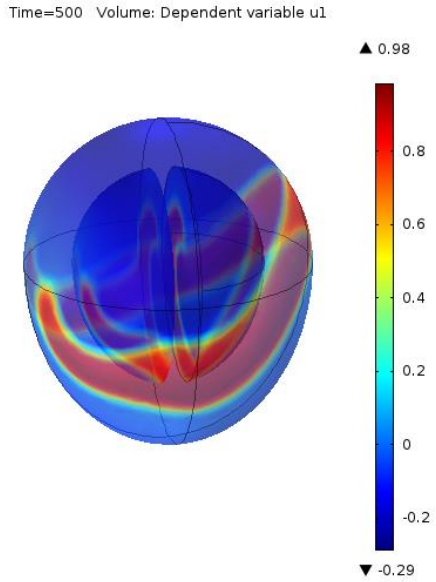
- COMSOL equation-based modelling is used to simulate the bio electrical signal propagation in cardiac tissue using the FitzHugh-Nagumo equations and the Complex Ginzburg-Landau equations.

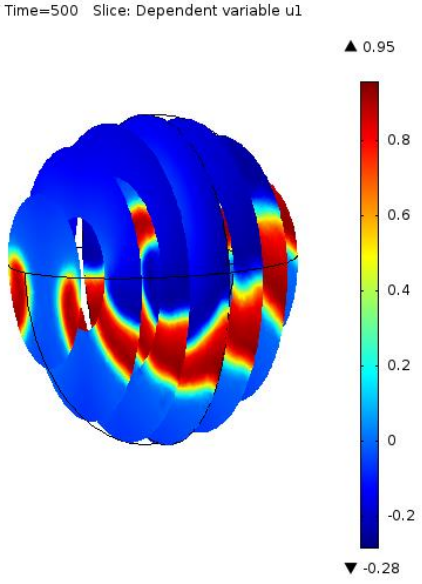


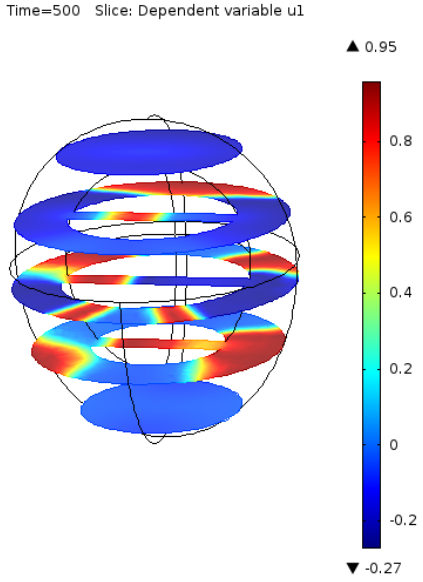
Simulation results: micro level

- Equation based simulation results of electrical signal propagation in the cardiac tissue.



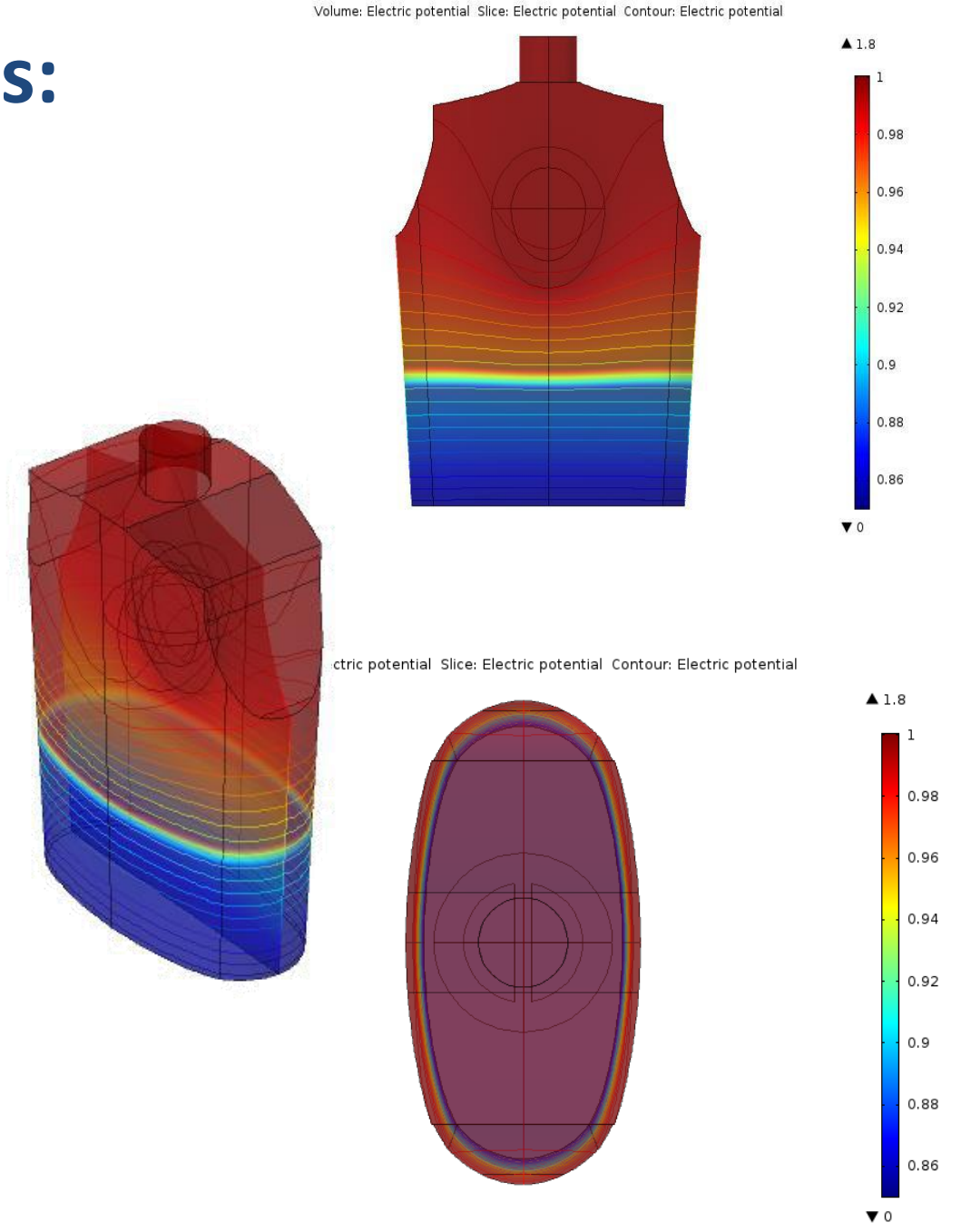






Simulation results: Macro level

- Electrical potential distribution in the torso and propagation from cardiac tissue to the outer skin.
- Coupled simulation for design and optimization.



Conclusions

- A conceptual smart sensor based chest belt was explored for viable product.
- The COMSOL simulation results shows feasibility of the concept for improved electrical potential mapping of the cardiac electrical signal.
- Next Steps: Couple Cellular level Electrical Signal to macro level for product optimisation.
- Future: Bio mimicking Smart skin