CAREER: Enabling "White-Box" Autonomy in Medical Cyber-Physical Systems

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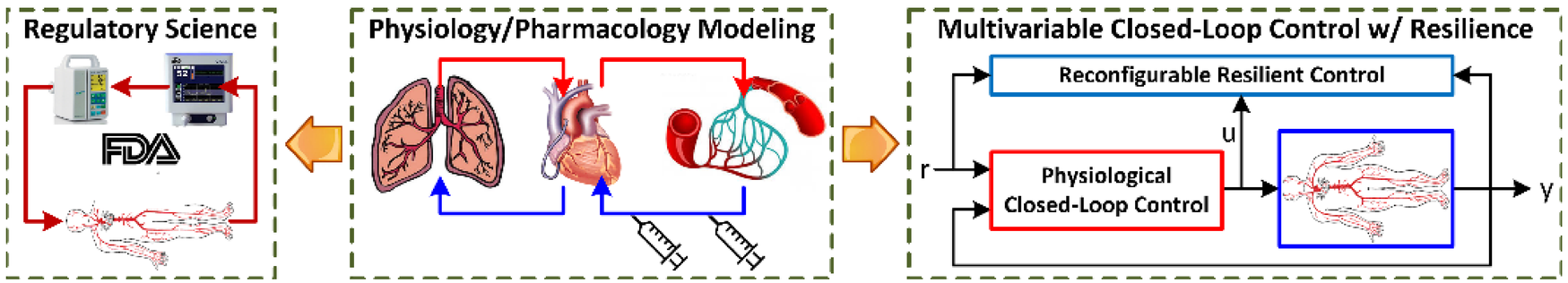
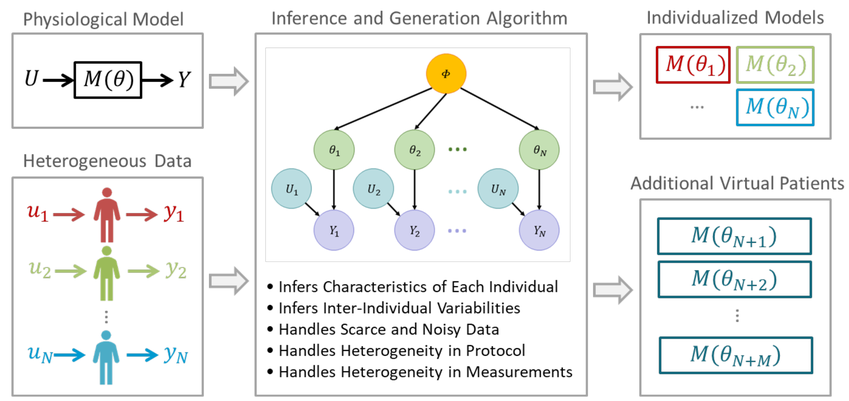
Challenge:

- Current closed-loop autonomy in healthcare is black-box in nature and not interpretable, limiting its clinical acceptance.
- Uninterpretable autonomy is prone to safety concerns in medicine.

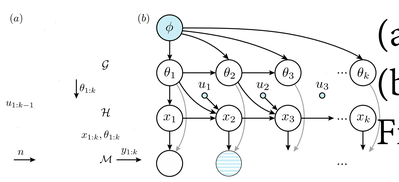
Solution:

- Digital twin (physiological models)
- DT-based virtual patient generation via ML inference
- Physiological monitoring & control based on DT and inference-based algorithms
- Translation to regulatory science

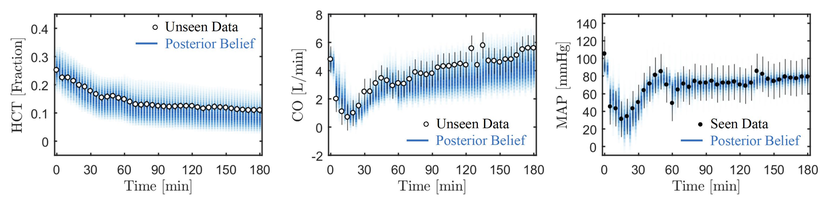




ML inference for Virtual Patient Generation



(a) Generative Physiological Model
(b) Population-Informed Particle Filtering Formulation



Physiological Monitoring via Population-Informed Particle Filter

Scientific Impact:

- Digital twins and ML inference-based estimation & control algorithms may be broadly applicable to closed-loop autonomy challenges in medical CPS domain.

Broader Impact:

- Healthcare: novel medical autonomy capabilities
- Regulatory sector: M-CPS testing tools and methodologies/tools
- Education: Next-generation workforce training in M-CPS domain

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