DIS 2026 Reframing Bite Block Removal Decisions as an Interaction Design Problem under Uncertainty

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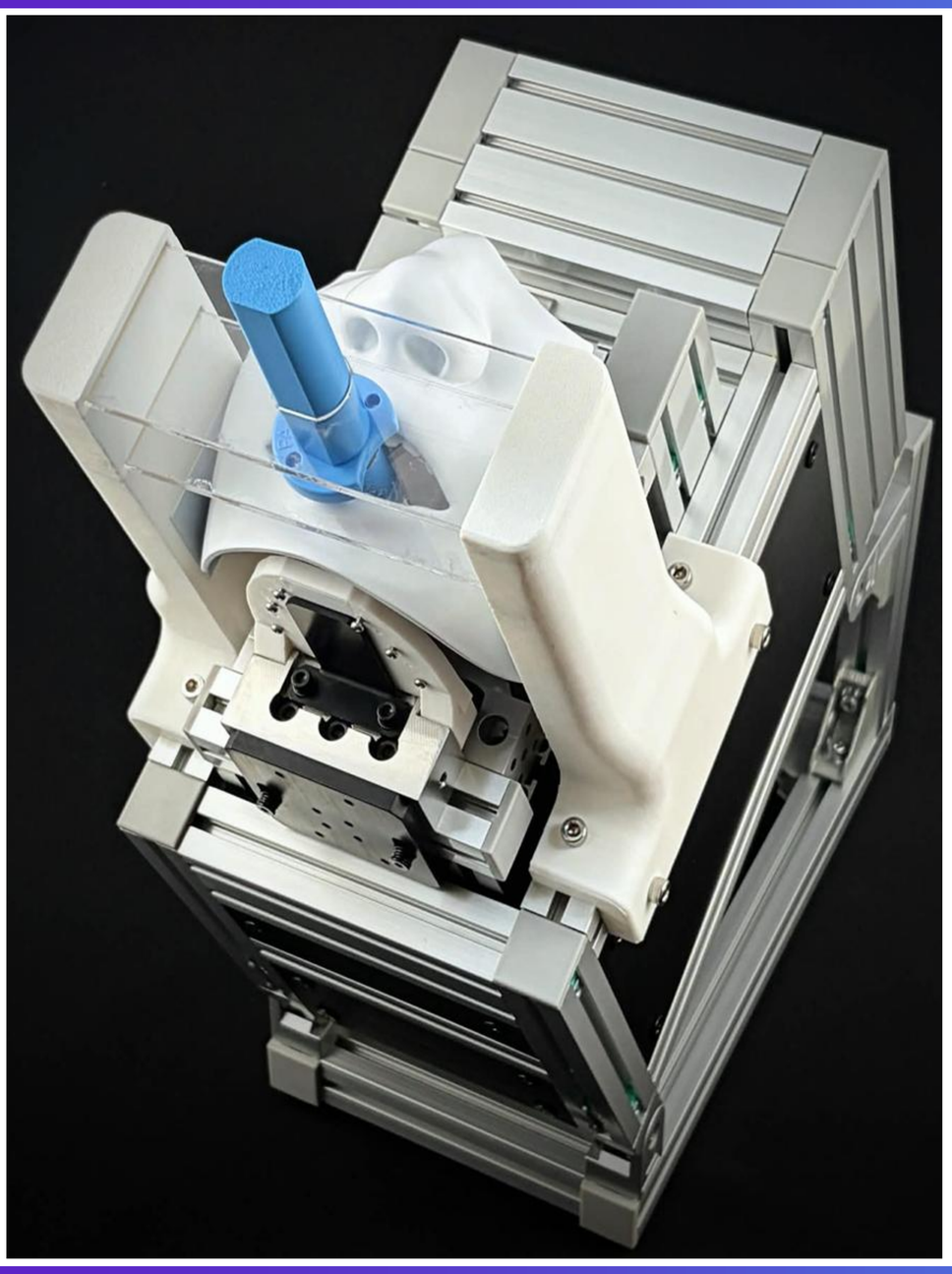
- Concept -

A bite block is commonly used during anesthesia management to prevent airway-related complications caused by involuntary biting. Although the device is generally kept in place to minimize occlusion risk, prolonged placement may cause pressure injuries in the oral cavity, creating a clinical trade-off between safety and tissue protection. **This study conceptualizes bite block removal and reinsertion decisions as an interaction design problem under uncertainty**. An AI-driven patient model generates unpredictable biting and grinding behaviors, while an operator determines when to remove or reinsert the bite block. Through this interaction, **the proposed framework investigates whether dynamic decision-making can balance occlusion risk and pressure injury prevention**, while offering a new perspective on bite block management under uncertainty.

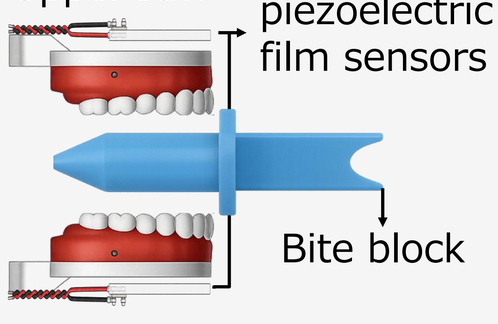
[1] C.Kim et al. : Oral mucosa pressure ulcers in intensive care unit patients: A preliminary observational study of incidence and risk factors. Journal of Tissue Viability. 2019

- Bite reflex -

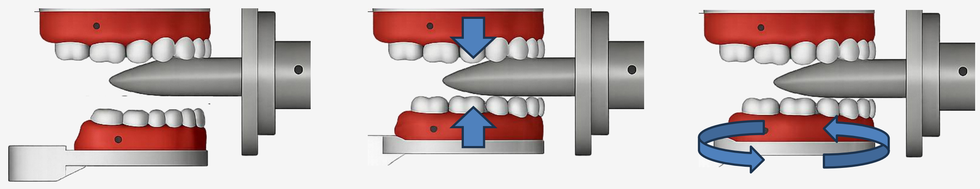


Oral structure and actions

Components



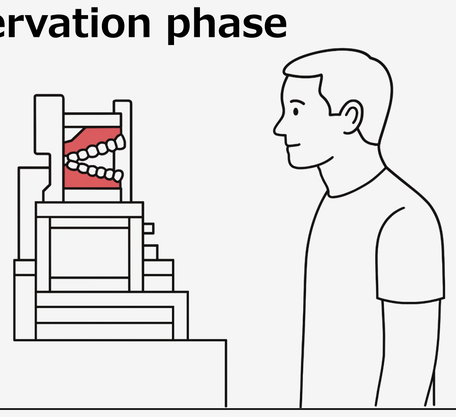
Actions



Occlusion : Classification based on sensor voltage signals
Actions : Biting, Teeth Grinding (Pre-occlusion Fake Motion)

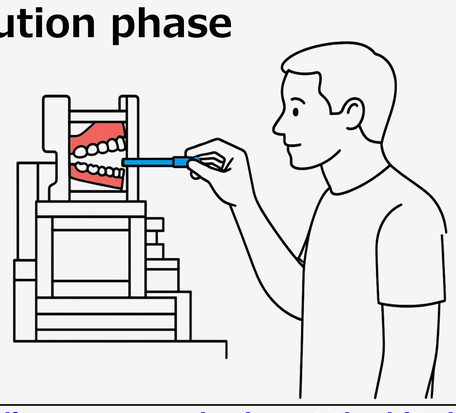
Experimental Procedure – Nurse vs Patient

Observation phase



Users observe stochastic variations in the patient's behavior and develop strategies for managing interactions with the patient.

Execution phase



Users repeatedly remove and reinsert the bite block while interacting with the device's biting actions, resulting in reciprocal rewards and penalties based on their decisions.

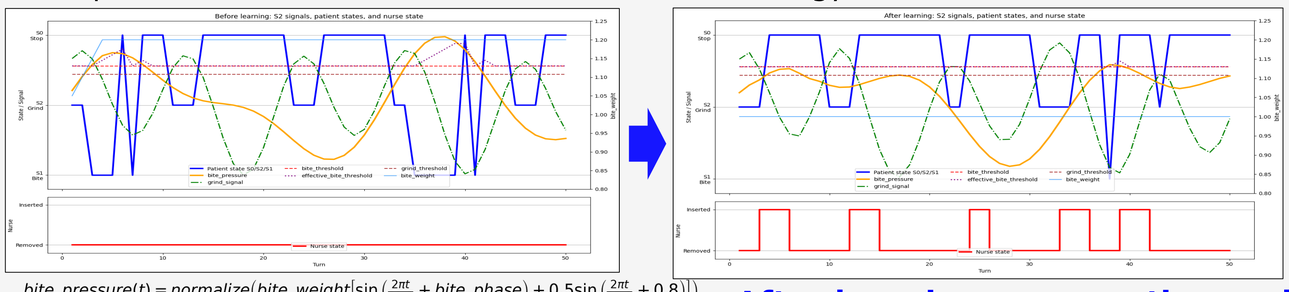
- Strategy -

Conditions

Strategy decision algorithm: DQN-based mutual adaptation model

- **Nurse AI (Bite Block Management)** : DQN
- **Patient AI (Stochastic Biting)** : P-DQN

After learning, consecutive occlusions were effectively suppressed, whereas the patient AI exhibited adaptive behavior by strategically shifting the timing of its biting attempts to circumvent the nurse AI's defensive strategy.



$$bite\_pressure(t) = normalize\left(bite\_weight\left[\sin\left(\frac{2\pi t}{30.0} + bite\_phase\right) + 0.5\sin\left(\frac{2\pi t}{17.0} + 0.8\right)\right]\right)$$

$$grind\_signal(t) = normalize\left(\sin\left(\frac{2\pi t}{11.0} + grind\_phase\right) + 0.4\sin\left(\frac{2\pi t}{23.0} + 0.0\right)\right)$$

Result

Item	Details	Result
Total Occlusions	Occlusions with block + Occlusions without block	**3**
Successful Defenses	Bite block was present during occlusion	**2**
Failed Defenses	Occlusion occurred while bite block was removed	**1**
Defense Success Rate	Successful Defenses ÷ Total Occlusions × 100	**66.7%**
Defense Failure Rate	Failed Defenses ÷ Total Occlusions × 100	**33.3%**

After learning, consecutive occlusions were suppressed, and the patient AI adapted its biting timing.

Future Work and Acknowledgment

Future work will incorporate physiological indicators such as blood pressure, pulse rate, and muscle tension into the model to develop a more clinically realistic patient model.

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