HITRI plus
Heavy Ion Therapy Research Integration

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NOVEL DESIGNS FOR TREATMENT, ACCELERATOR CONTROL SOFTWARE, AND SAFETY SYSTEMS

DECADES OF EXPERIENCE IN ACCELERATOR DESIGN, CONSTRUCTION AND OPERATION ON CONTROL SOFTWARE FOR DIFFERENT APPLICATIONS AND SAFETY SYSTEMS

NOVEL DESIGNS TREATMENT CONTROL SYSTEM

Investigating advancements in treatment control systems, planned developments have been identified in existing systems and desired features for future designs. Many solutions are already implemented in Cosylab's TreatmentOne system or are part of a planned design.

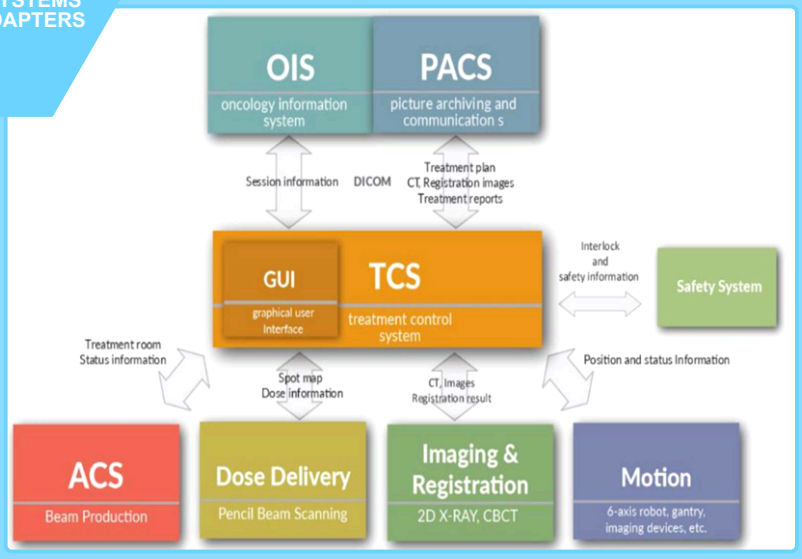
Features include support for various particles (including ions), imaging systems, additional hardware, treatment sequences, and modes like supine and upright treatments.

Proposed solutions also address non-functional requirements such as distributed systems, adaptability, modularity, communication and expandability.

Distributed systems offer advantages over monolithic ones, allowing changes without impacting the entire system. Adapters separate external systems and internal logic during updates, enhancing adaptability and flexibility. Building the system with independent, interchangeable modules enables support for different modalities and extensions, improving development and verification time.

Reusing validated components from previous machines reduces costs and development time, while tailoring the system to patient needs.
A collaboration between the Oncology Information System and the Treatment Control System is crucial for treatment plan preparation and execution.

TREATMENT CONTROL SYSTEM AND ITS CONNECTION TO EXTERNAL SYSTEMS THROUGH ADAPTERS



CHALLENGE

The treatment control system ensures precision, safety, and effectiveness in particle therapy delivery.
Current heavy ion therapy solutions lack optimal quality, user-friendliness, and patient safety.
Challenges include the complexity of multi-species setups and high upfront and operating costs.

SOLUTION

Proposed design solutions for heavy ion centres aim to lower treatment room software costs. These solutions focus on distributed systems, adaptability, and modularity, resulting in a safer, user-friendly system. Reduced treatment time and staffing needs enhance cost efficiency, improving treatment availability.
The system allows easy integration of upgrades for continual evolution.

VALUE

Critical system faults can be swiftly recovered without significant time loss. Utilizing distributed systems, each component operates independently in the treatment control system, allowing for flexibility and scalability.
Updates to the system can be easily managed with simple monitoring, and additional features can be seamlessly added without requiring full system verification. Stability can be ensured, as components automatically restart in case of shutdown, maintaining system integrity.
Sensitive services are isolated to prevent interference with critical functions. Upgrades are straightforward, with the ability to reuse existing components and integrate new hardware systems.
The decoupling concept enables support for various modalities and features, including novel treatment methods like Arc Therapy and FLASH.
Technicians gain from a unified user experience throughout the workflow, reducing complexity and minimizing errors.

NOVEL DESIGNS ACCELERATOR CONTROL SYSTEM

The accelerator control system acts as the core intelligence of the medical synchrotron. Its main role is to oversee and coordinate multiple devices to generate a customized beam for heavy ion therapy. The system must meet requirements such as supplying the accelerator ring with the necessary particles per second to generate the beam.
Package will develop a multi-tier control system architecture and design for this purpose. The concepts and solutions aim to ensure fast commissioning, machine QA, high reliability, ease of use, and cost reduction.

CHALLENGE

Many current accelerator control system solutions have suboptimal architectures and rely on non-standard and unstable electronic components.
Multi-species treatments and innovations like FLASH hadron therapy bring new challenges that require advanced techniques such as multi-energy extraction to resolve.

SOLUTION

An accelerator control system will be designed, drawing on the latest concepts from cutting-edge solutions in both research and clinical facilities. This will yield a multi-tier system architecture and a set of engineering requirements.

VALUE

A future-proof design of the control system architecture will accommodate both clinical and research needs. The system will be efficiently deployed, verified, and tested to ensure rapid commissioning and machine quality assurance.
Development will prioritize user-friendliness, intuitive interfaces, and streamlined workflows tailored to personnel at heavy ion therapy centres, including those without a clinical background.
The system's high reliability will reduce operational costs by minimizing downtime, maintenance, and repair expenses, while maximizing efficiency.
The architectural model will support multiple-energy extraction mode, reducing treatment duration and enhancing cost efficiency.
Integration of FLASH and Arc Therapy will be feasible, opening doors to future treatment methodologies.

NOVEL DESIGNS PATIENT SAFETY SYSTEM DESIGN

When using a particle accelerator for medical treatment, ensuring safety is paramount. State-of-the-art safety control systems on the market have been analyzed here, with the most promising solutions benchmarked and leveraged for a new system that will include beam delivery and irradiation.
This will result in an architecture and design for safety systems as required by current European regulations.

Compliance with European Regulation (EU) 2017/745, known as the Medical Device Regulation (MDR), is essential for patient safety. The safety control system for the particle therapy accelerator itself is considered a class IIb medical device. Currently, there is no industrial standard harmonized with the MDR. However, adhering to the EN 60601-1 standard family for medical electrical equipment, along with the specific standard EN 60601-2-64 for light ion beam medical electrical equipment, is considered state-of-the-art

CHALLENGE

Multiple limitations exist in current designs of patient safety systems. Standardization and potential for upgrades and optimization are often severely restricted due to system complexity. Additional complexities in the accelerator control system can introduce additional risks to the patient that need to be mitigated, such as independently confirming the species being delivered in a multi-species setup.

SOLUTION

The patient safety system will offer user-friendly solutions, ensuring seamless integration of new treatment modalities while fully complying with European regulations.

VALUE

The accelerator design will align with the patient safety system, ensuring flexibility to accommodate future technical and medical advancements throughout the facility's lifespan. This streamlined architecture offers optimized performance and robustness, resulting in reduced maintenance and operational efforts, faster treatment times and lower investment costs.