

FROG: a platform for rapid and robust clinical dose calculations in hadron therapy



HEIDELBERG
UNIVERSITY
HOSPITAL

A. Mairani^{1,2}, K. Choi^{2,3}, B. Kopp^{4,1,5}, S. Mein^{4,1,5}

¹Heidelberg Ion-Beam Therapy Center (HIT), Heidelberg, Germany; ²Centro Nazionale di Adroterapia Oncologica (CNAO), Pavia, Italy; ³University of Pavia, Department of Physics, Pavia, Italy; ⁴German Cancer Research Center (DKFZ), Translational Radiation Oncology, German Cancer Consortium (DKTK) Core Center, Heidelberg, Germany; ⁵Heidelberg University, Faculty of Physics, Heidelberg, Germany

The FROG Platform

- In-house developed at HIT and CNAO
- Advanced pencil beam algorithm
- Fast calculation times through GPU usage
- Flexible framework with Python foundation
- MC-like accuracy
- ...



FROG is developed and maintained by the Heidelberg Biophysics in Particle Therapy Group (BioPT) in collaboration with CNAO.

FROG in 2019

Advanced Calculations

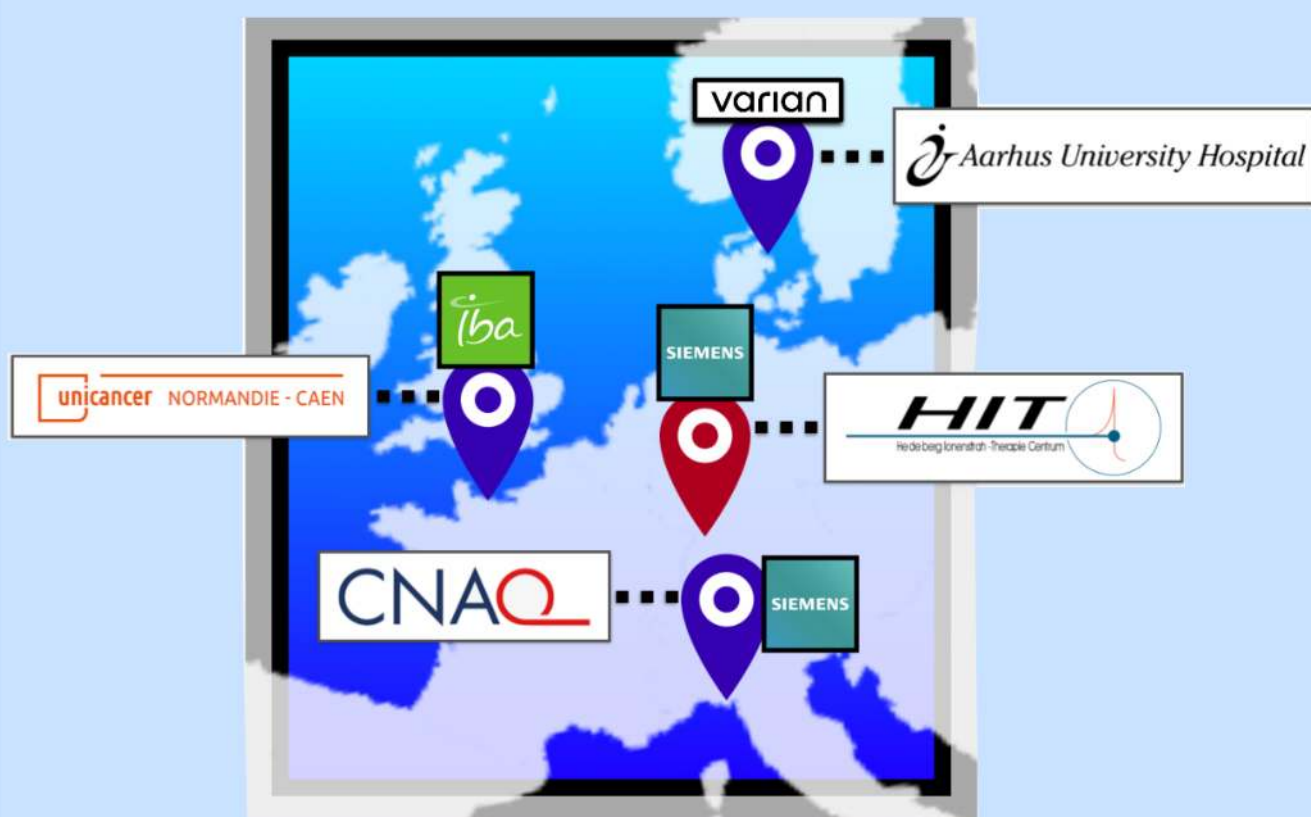
- Combined ion therapy with constant RBE (CICR) optimizations
- Clinical outcome study of TPC and NTCP

Currently under development

- FROG MC: proton Monte Carlo on GPU
- FROG GPU Optimizer for fast reoptimization and recalculation at HIT
- Providing a platform for range verification (prompt gamma, prompt particle, PET)
- FROG hypoxia estimation

FROG clinical applications

FROG is currently installed and employed at four clinical facilities in Europe.



FROG at PTCOG58

Oral Presentations:

K. Choi et al.: *New modalities for FROG: Sandbox strategy applied to pelvic cancer patients treated with carbon ion therapy*

Poster Presentations:

A. Mairani et al.: *Raster-Scanning Helium (⁴He) ion beam therapy: development and validation of a novel treatment planning system for biophysical modeling and optimization in the clinic*

T. Tessonier et al.: *Integration and application of an independent GPU-based dose engine (FROG) at the Normandy Proton Therapy Center*

B. Kopp et al.: *Implementation and commissioning of the FROG framework at the Danish Centre for Particle Therapy*

B. Kopp et al.: *Multi-ion biological and physical dose optimization with the FROG framework*

CNAO

HIT
Heidelberger Ionenstrahl-Therapiezentrum



Email about FROG:
Andrea.Mairani@med.uni-heidelberg.de



Email about FROG at CNAO:
Kyungdon.Choi@cnao.it



Email about FROG Optimizer:
B.Kopp@dkfz-heidelberg.de



Email about FROG at HIT:
S.Mein@dkfz-heidelberg.de

