# ContraCancrum

## Clinically Oriented Translational Cancer Multilevel Modelling

**The ContraCancrum project aims at developing a composite multilevel platform for simulating malignant tumour development and tumour and normal tissue response to therapeutic modalities and treatment schedules in order to optimise the disease treatment procedure in the patient's individualized context.**

## Objectives of the Project

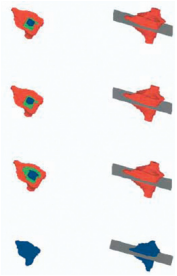
The Contra Cancrum project aims at developing an advanced multiscale simulation platform of tumour growth and response to treatment, driven by real clinical needs, and initiating the clinical translation process of the simulation system within the context of clinical trials/tests. To this end, development of simulation modules covering several scales of the natural phenomenon of cancer and their integration into a unique system is to taking place while the user requirements and clinical scenarios have been already well defined. At the same time, a well designed clinical/medical data based validation of the integrated simulation system has been planned in order to adapt, optimize and validate the latter with the ultimate goal being the demonstration of its clinical usefulness in current treatment practices and cancer therapy optimisation.

**By utilizing a simulator, the clinician will be able to perform in silico (on the computer) experiments corresponding to different candidate therapeutic scenarios for any cancer patient in order to facilitate and better substantiate his or her treatment decisions.**

ContraCancrum will take cancer modelling research a step further by integrating molecular, cellular, tissue and higher level modelling concepts into a single technological entity that will simulate therapy outcome based on the individual patient information. This could serve as a powerful weapon to better understand and fight cancer.

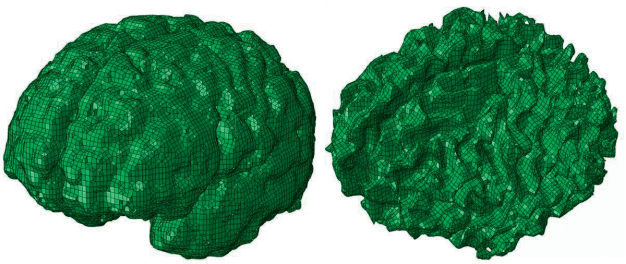
## Project Description

ContraCancrum is bringing together different levels of biocomplexity into an integrated simulator. The project will model and simulate cancer/normal tissue behaviour at different levels of biocomplexity. The models take into consideration all relevant patient information (including histopathology, medical imaging and clinical data for each patient), in order to model the individual response to cancer therapy. This technology can optimise therapy design and minimise patient discomfort and suffering that can be induced when administering sub-optimal therapies. For the needs of running simulations, ContraCancrum has been awarded support and CPU time through the VPH DEISA Virtual Community (600,000 CPU hours on DEISA resources).



Contra Cancrum is:

- Developing medical image analysis algorithms and software for extracting pathophysiological information from different levels of diagnostic information (e.g. MRI, CT, PET, and ultrasound. Several bio-medical parameters/markers will be tested in order to optimize information extraction from treatment monitoring medical images. Open access tools can be downloaded at http://biomodeling.ics.forth.gr/.
- Developing macroscopic biomechanical finite element models of the brain and lung to calculate the stress/strain in these tissues. Deformations of both tumour and neighbouring normal tissues will be simulates based on tissue biomechanical properties and detailed anatomic atlases.



*Voxel mesh of the grey and white matter obtained with the automatic meshing tool.*

**CASE STUDY / PRACTICAL EXAMPLE / SCENARIO**

ContraCancrum is deploying two new dedicated clinicogenomic studies in (a) gliomas (b) lung cancer in order to pave the way for the use of modelling assisted therapy design into clinical practice. It has been established that gliomas are the most common primary central nervous system neoplasms, while Lung cancer is the leading category of cancer death in men, and—since the late 1980s—it has surpassed breast cancer as the leading category of cancer death in women. ContraCancrum will integrate and optimise the simulator for implementing the clinical studies. Six University Hospital Departments possessing world acclaimed expertise in running clinical trials will provide multilevel and multimodality sets of data for about 200 patients per year (including both glioma and lung cancer cases).

- Deploying two important clinical studies for validating the models, one on lung cancer and one on gliomas. The crucial validation work will be based on comparing the multi-level therapy simulation predictions with the actual medical data (including medical images), acquired before and after therapy. Data pseudonymization is ensuring adoption of the European legal and ethical data handling guidelines.
- Creating a workflow environment that will allow remote access to clinical data and will assist the end clinical user to validate the cancer models by using its web services. The project is using use open-source software that allows for future extensions of models as well as the extension to large scale clinical trials.

Clinical protocols have been established for securely uploading pseudo-anonymised clinical imaging (DICOM) data and currently 7.2 GB of patient-specific datasets, comprising mainly of glioma cases have already been uploaded. A secure interface has been developed for project members such that they can download DICOM datasets as separate files or compressed archives of DICOM datasets.

# Expected Results & Impact

ContraCancrum will lead to a 'modelling aided' optimal treatment design prototype that will positively influence the treatment outcome. The project will:

- Achieve more effective healthcare by selecting the optimal therapy for an individual patient.
- Contribute to the development of safer drugs and medical devices [e.g. radiotherapy treatment systems] by providing estimates of the adverse effects of chemotherapy and radiotherapy in parallel with the predictions of tumour response.
- Attract the pharmaceutical industry back to Europe, since its methods will allow the implementation of clinical trials in a more cost effective way.
- Contribute to the understanding of mechanisms of carcinogenesis and tumour growth at several biocomplexity levels.
- Optimise of the design and efficiency of new clinical trials aiming at improving cancer treatment in groups of patients sharing some common pathological characteristics.
- Educate both medical students and interested patients or patients' parents via simulation experiments and visualization of the model's predictions.

**ContraCancrum is expected to contribute to the achievement of higher cancer cure rates for the potentially curable patients whereas for the non curable patients it is expected to contribute to the achievement of increased life expectancy and better quality of life.**

## ContraCancrum

**Oriented Translational Cancer Multilevel Modelling**

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**KEYWORDS**
Virtual physiological human, Simulation, Cancer multilevel modelling, Therapy simulation, Modelling assisted therapy.