Improved Vascular Transport Function Characterization in DSC-MRI via Deconvolution with Dispersion-Compliant Bases

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Improved **Vascular Transport Function Characterization** in **DSC-MRI** via Deconvolution with **D**ispersion-**C**ompliant **B**ases

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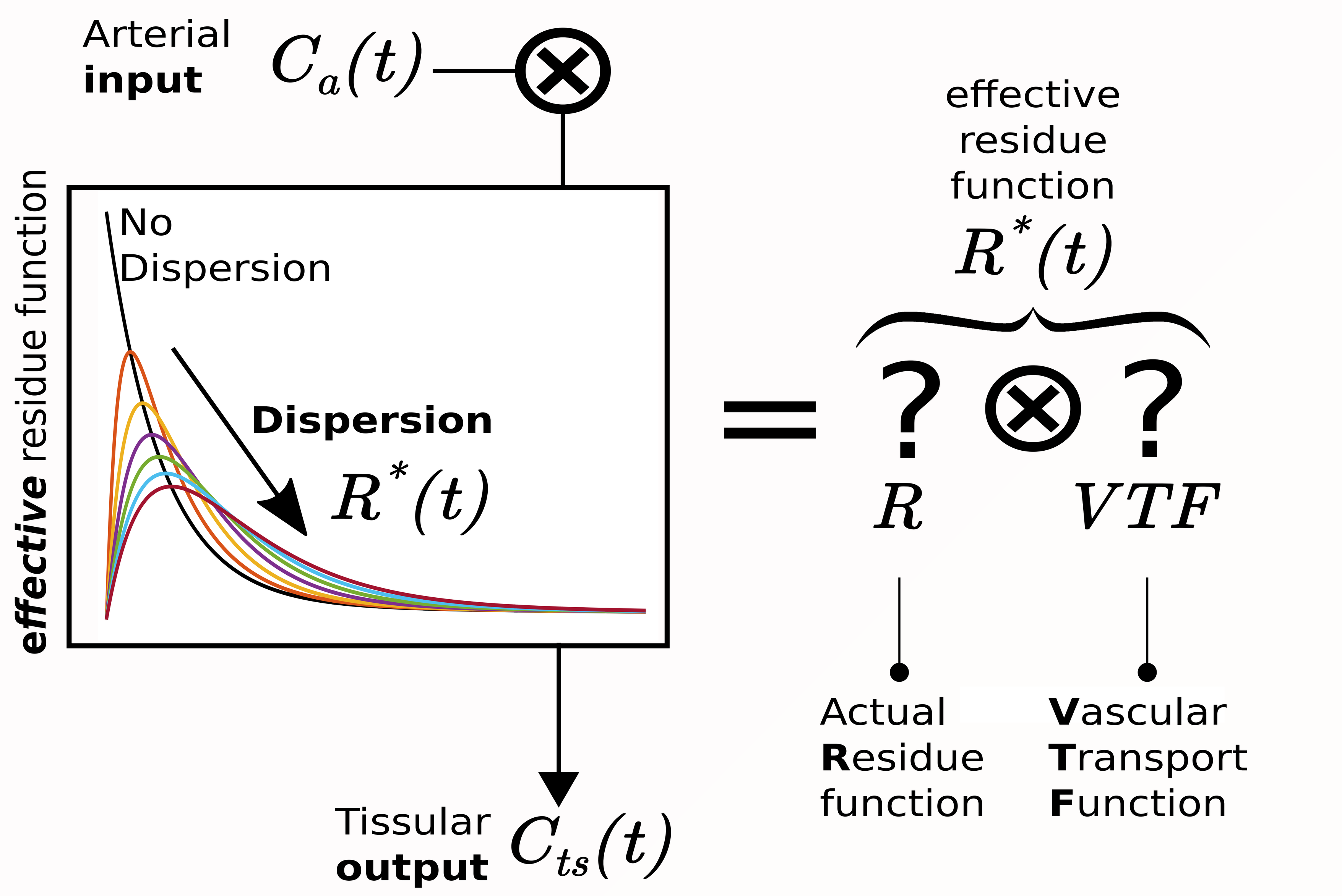
Bolus **dispersion** affects the residue function computed via deconvolution of DSC-MRI data. The obtained **effective** residue function can be expressed as the convolution of the true one with a **Vascular Transport Function** (VTF) that characterizes dispersion. The state-of-the-art technique CPI+VTF allows to estimate the actual residue function by assuming a model of VTF. We propose to perform deconvolution representing the effective residue function with Dispersion-Compliant Bases (DCB) with **no assumptions on the VTF**, and then apply the CPI+VTF on **DCB** results, to **improve performance**.

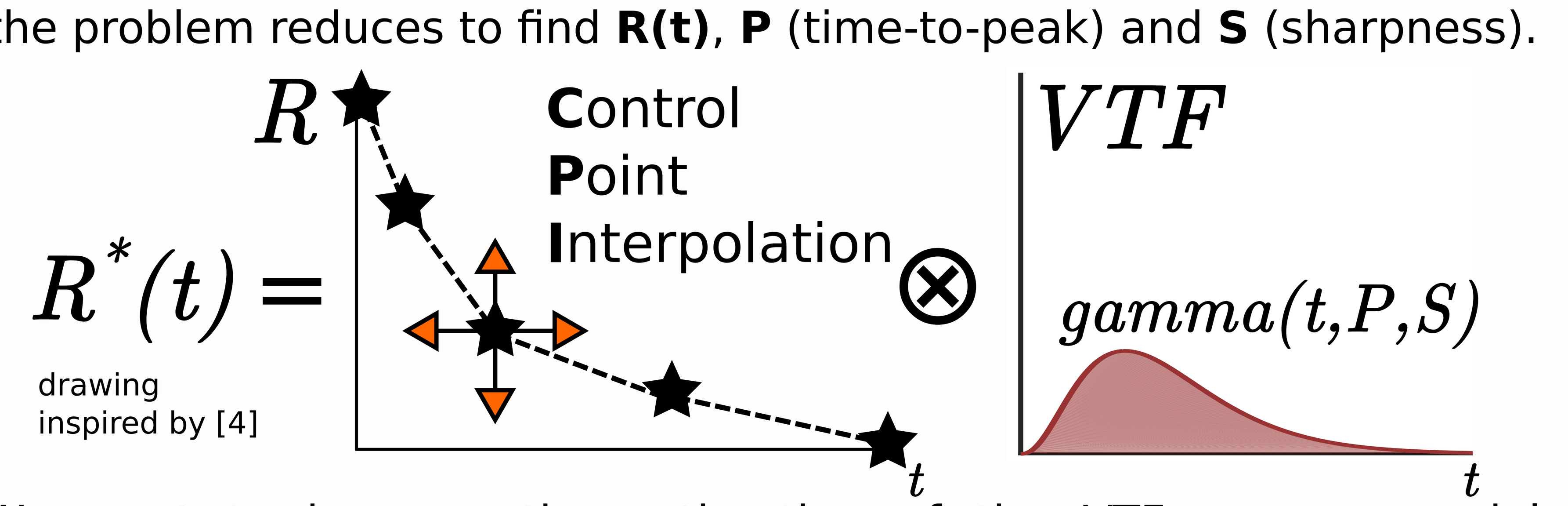
1 Perfusion problem & Dispersion

Given the arterial input and tissular output, estimate the **residue function** in the presence of **dispersion** via **deconvolution.**



2 Problem statement

We want to estimate $R(t)$ and $VTF(t)$. We use **CPI+VTF**[4] (a non-linear VTF model-based approach) that assumes $VTF(t)=gamma(t,P,S)$, so the problem reduces to find **R(t)**, **P** (time-to-peak) and **S** (sharpness).



We want to improve the estimation of the VTF gamma model parameters, P and S, compared to the standard approach.

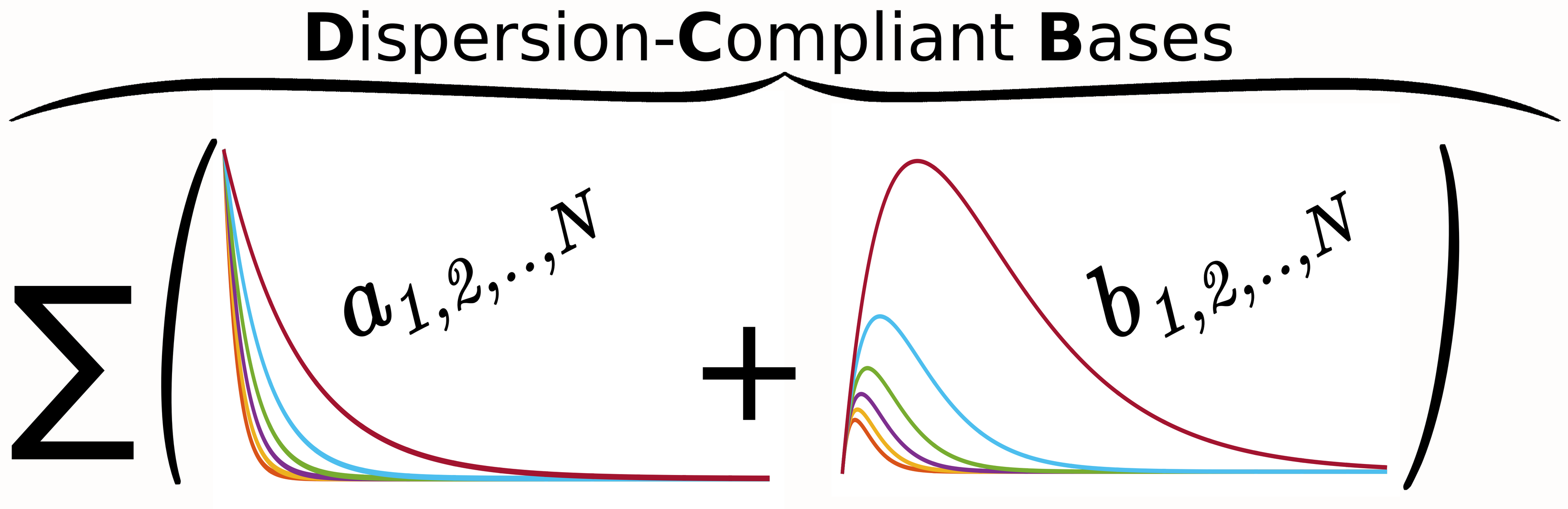
3 Our approach: DCB

We use bases[6] precisely designed to recover the *effective* residue function by means of deconvolution: **linear estimation**, **positive solution of R***.

$$R^*(t) = \Theta(t-\tau)\sum_{n=1}^{N}[a_n + b_n(t-\tau)]e^{-\frac{n(t-\tau)}{MTT_0}}$$

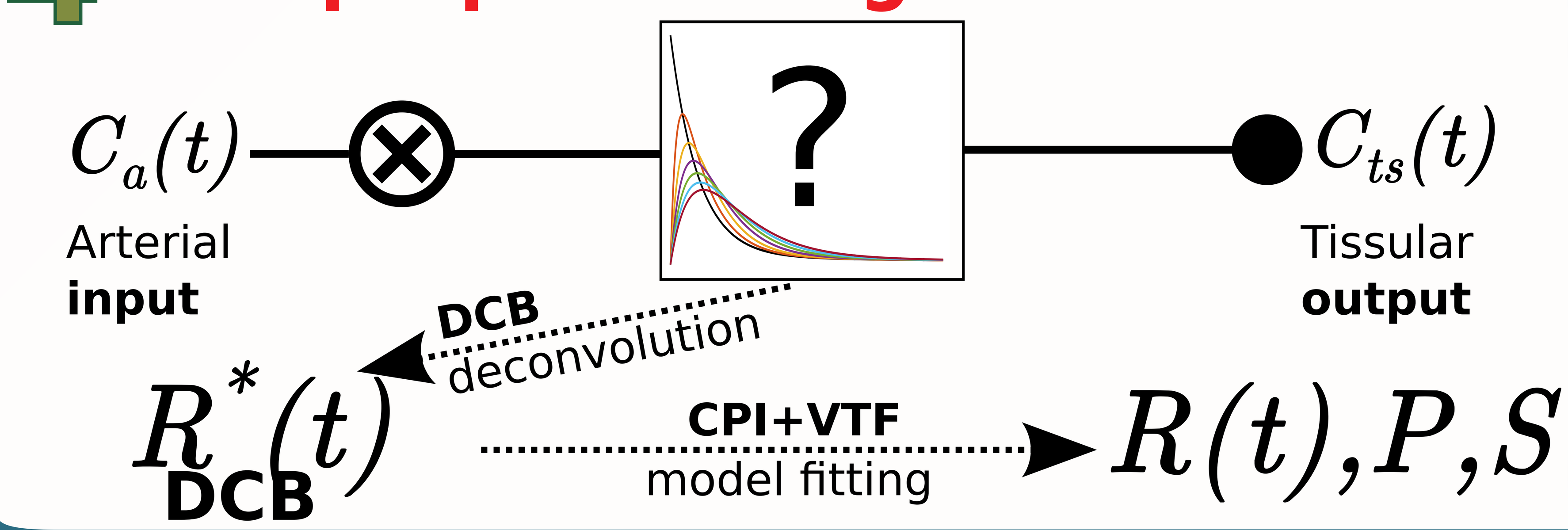
N maximum basis order; $\Theta(\cdot)$ unit step function;
a_n, b_n coefficients; MTT_0 expected MTT;

Dispersion-**C**ompliant **B**ases



No assumptions on VTF

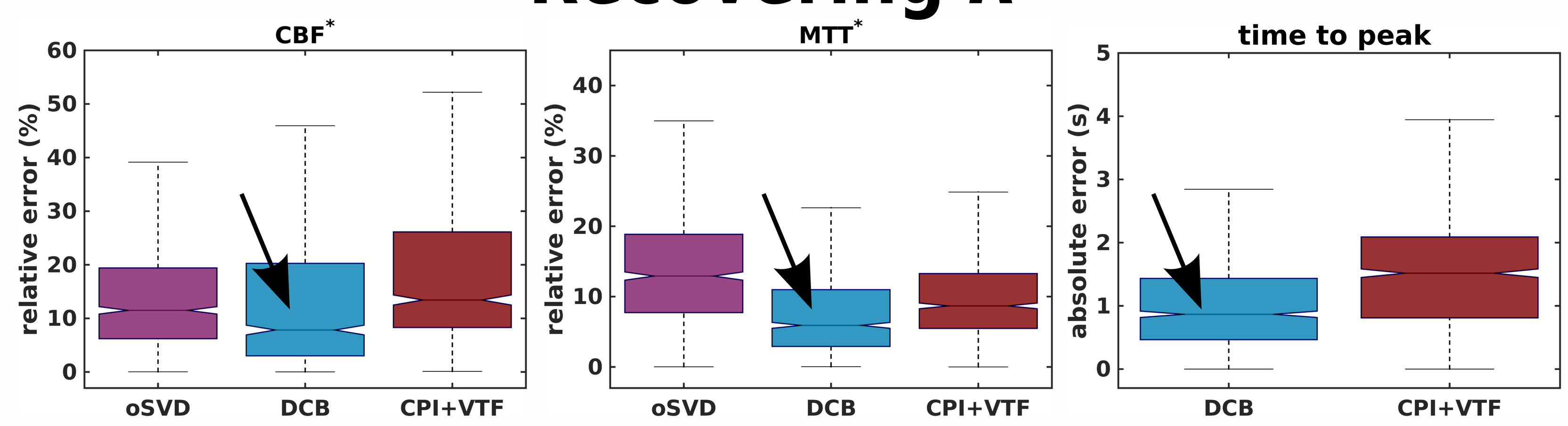
4 DCB preprocessing for CPI+VTF



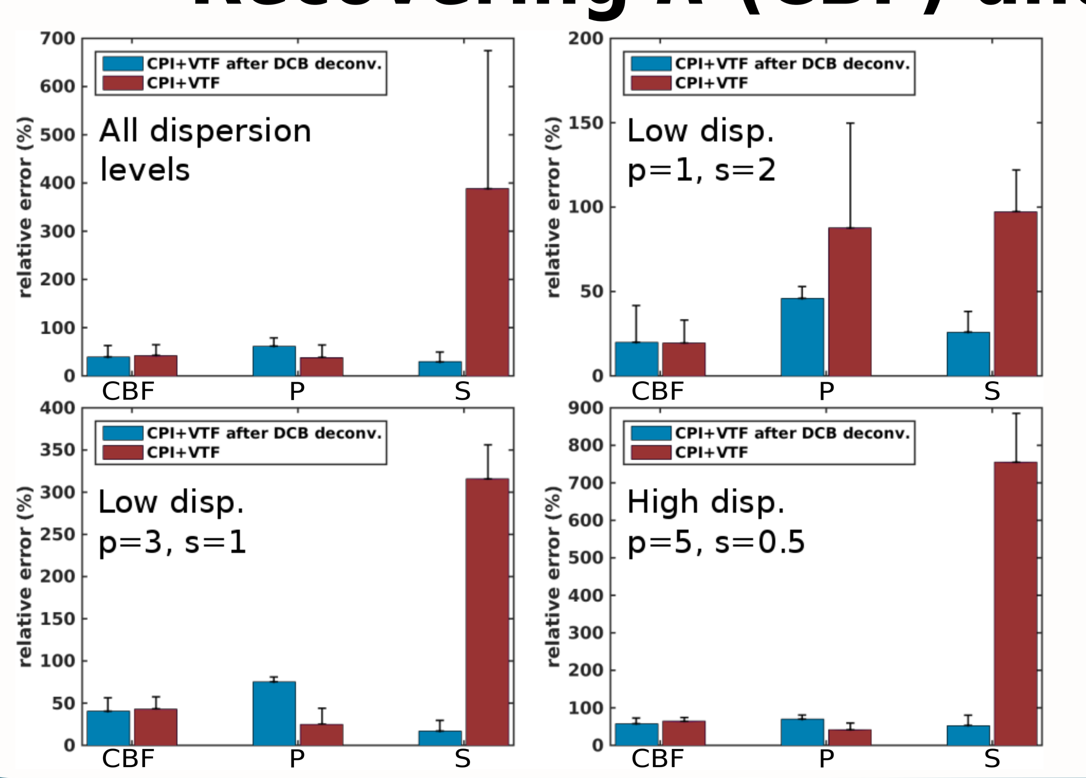
5 Experiments *in silico*

We generate data with different Dispersion Kernels (gamma, exponential, lognormal) and dispersion intensity (low, medium, high).

Recovering *R**



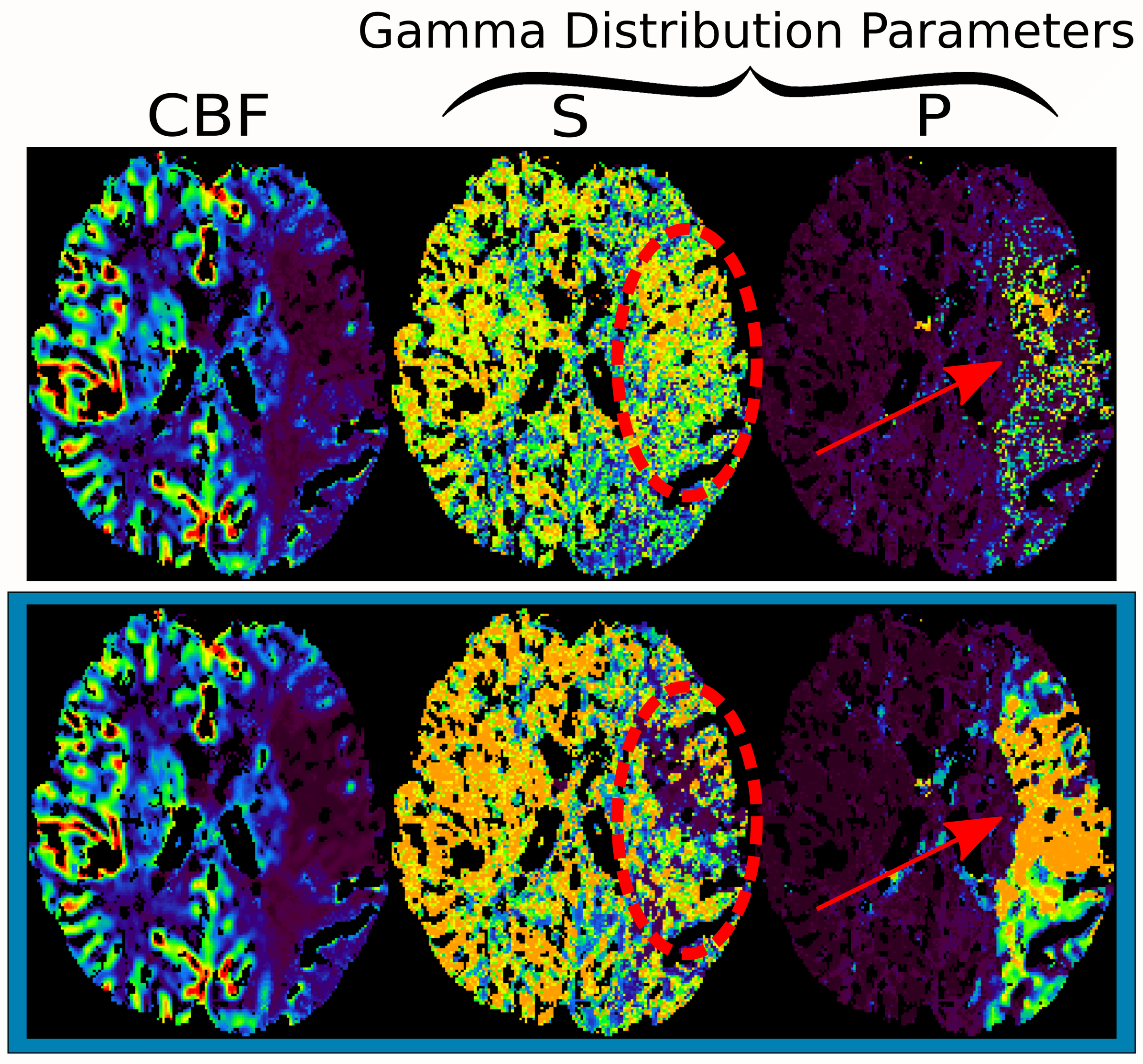
Recovering *R* (CBF) and *VTF* (P,S)



DCB improve the estimation of ***effective*** parameters, such as CBF*, MTT*, TTP.

DCB allow to better recover the **C**erebral **B**lood **F**low and the VTF (P,S).

6 *Right* occlusion



CPI+VTF

Proposed **DCB** preprocessing

The authors express their thanks to Olea Medical and the Provence-Alpes-Côte d'Azur Regional Council for providing grant and support.

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