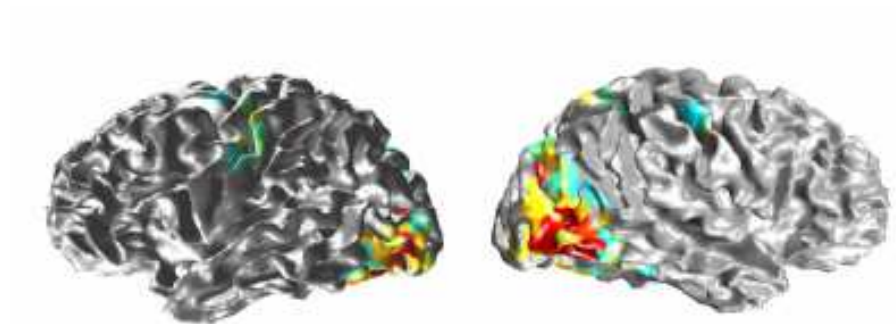
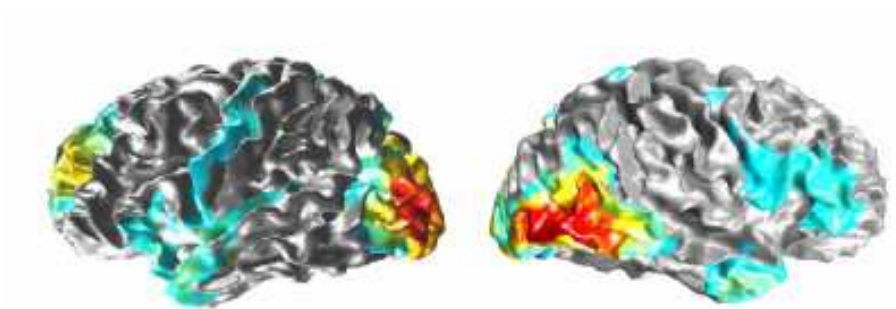


Fusion de l'EEG et de l'IRMf

Introduction

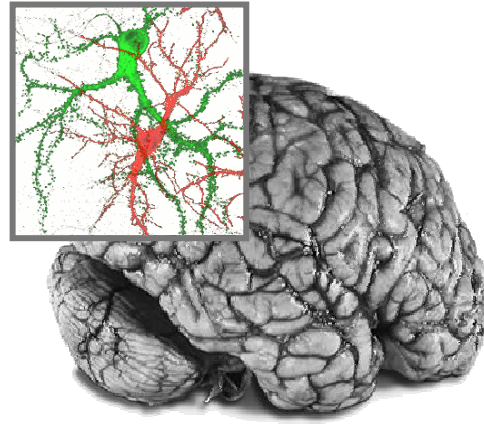


IRMf

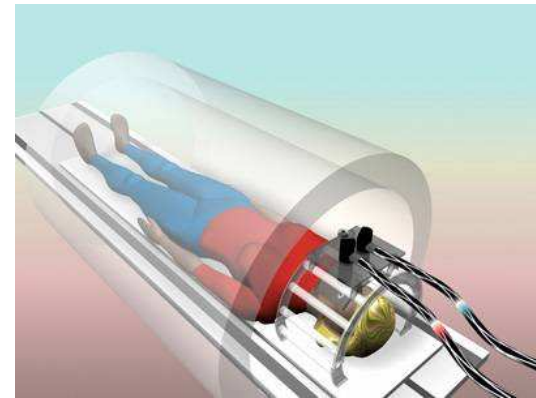
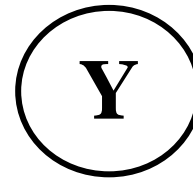
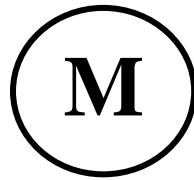


EEG

Introduction

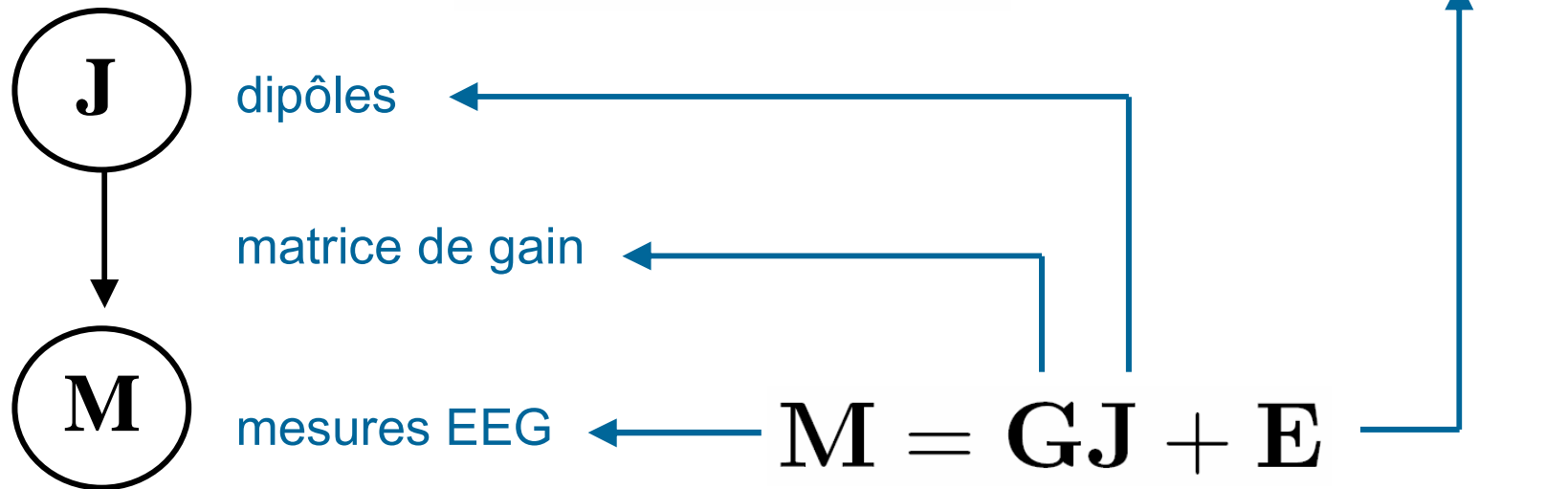
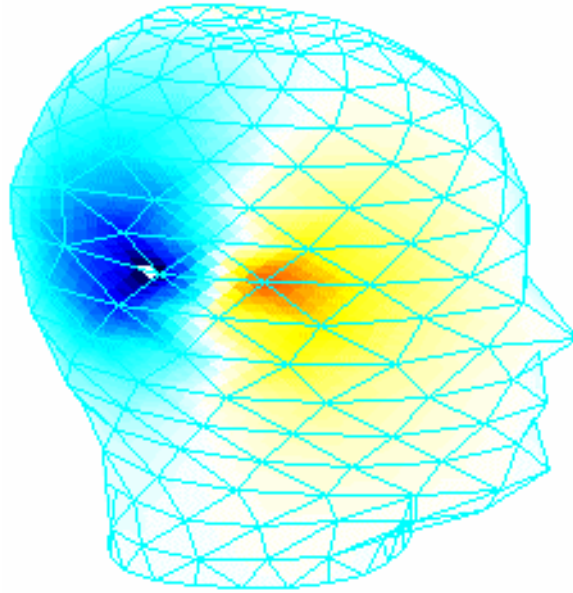


EEG

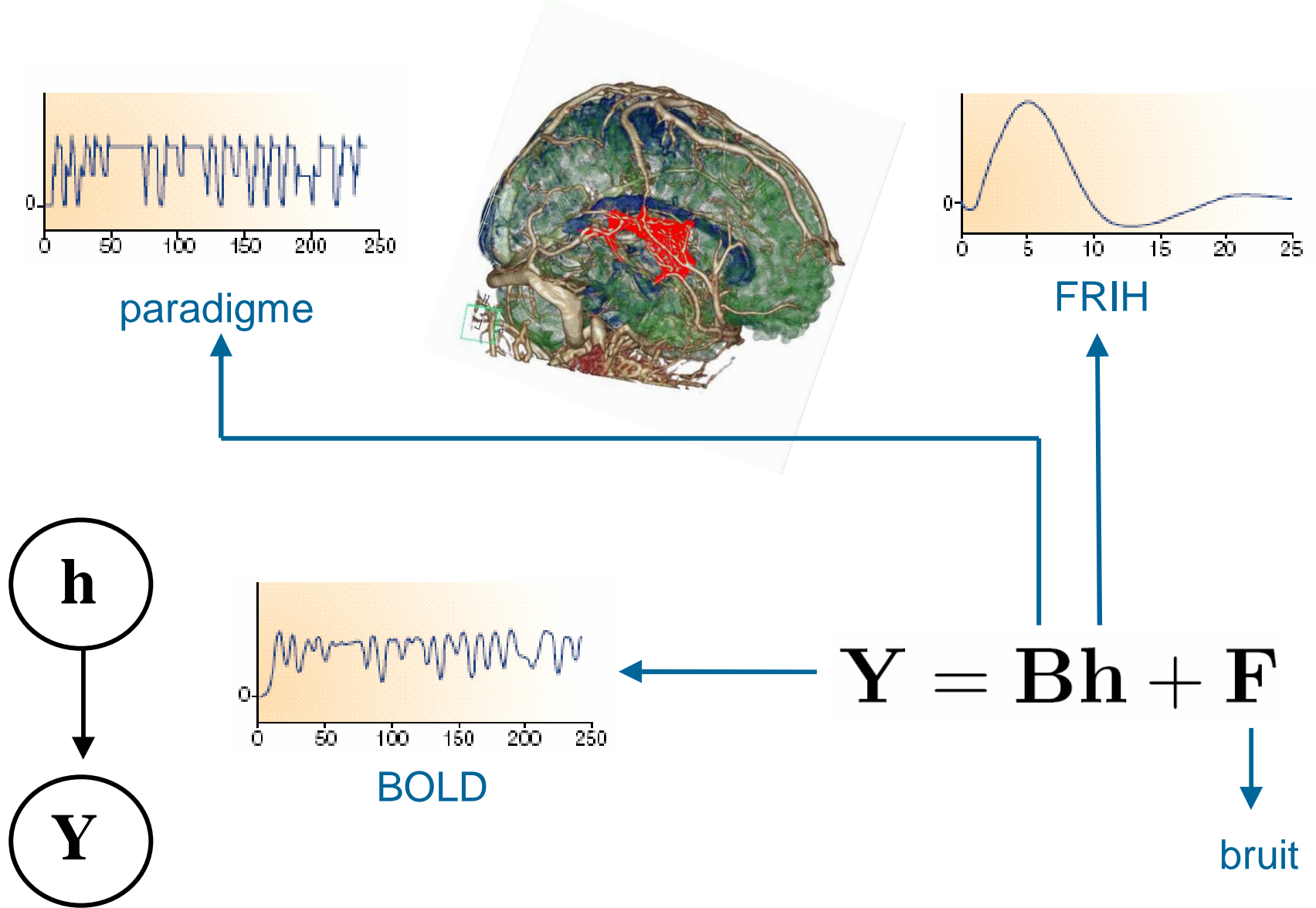


IRMf

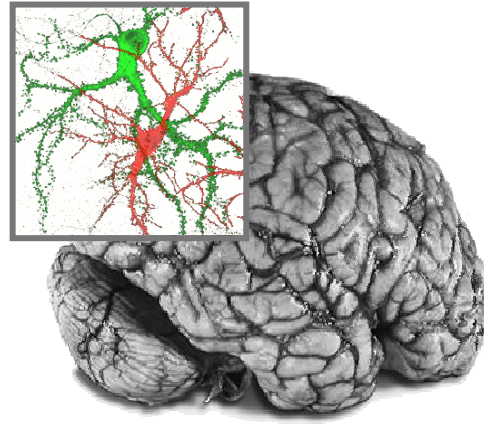
Introduction



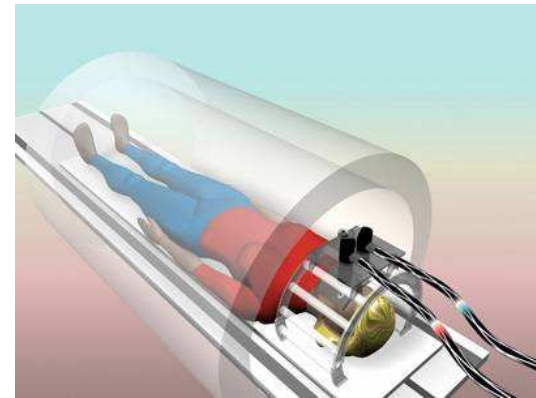
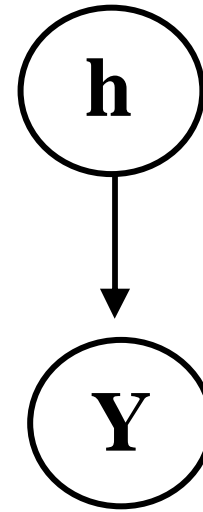
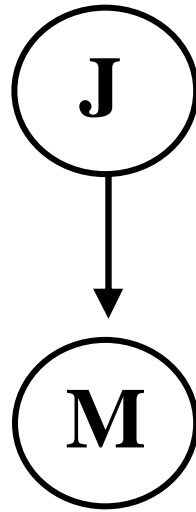
Introduction



Introduction

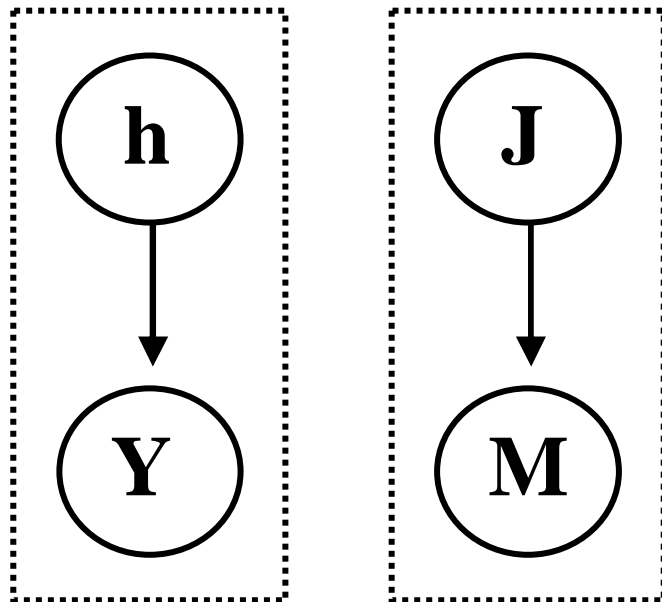


EEG

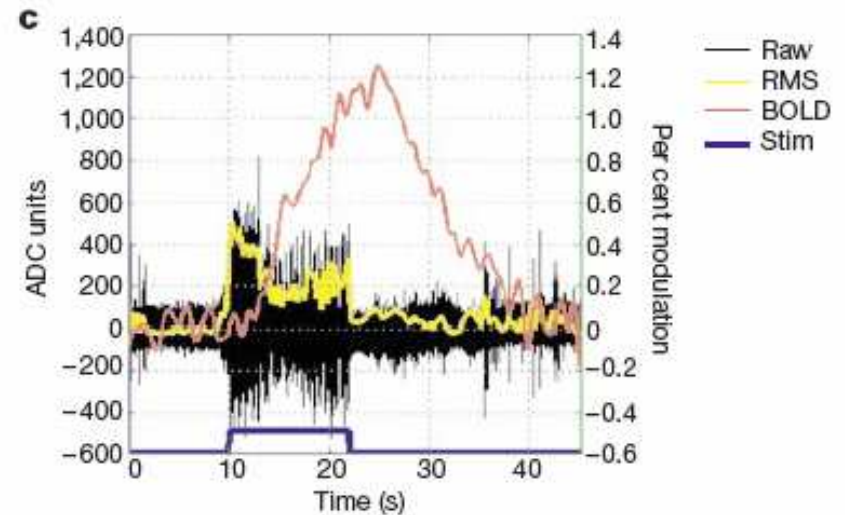


IRMf

lien entre activités bioélectrique et hémodynamique ?



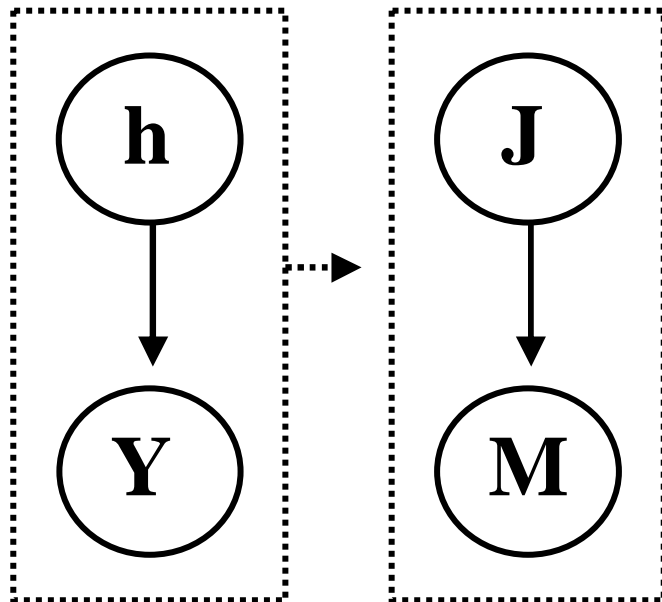
dynamique des activités
bioélectrique et hémodynamique



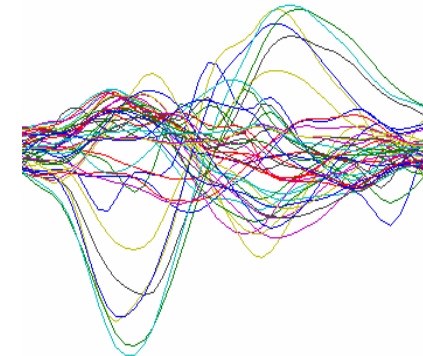
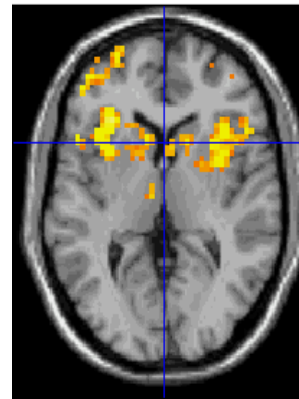
Logothetis et al., 2001

fusion contrainte

résolution spatio-temporelle ++

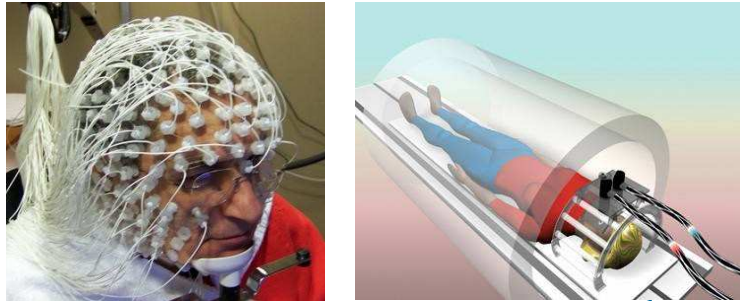


introduction information spatiale
IRMf *a priori* dans le problème
inverse EEG



Dale et al., 2000

fusion contrainte

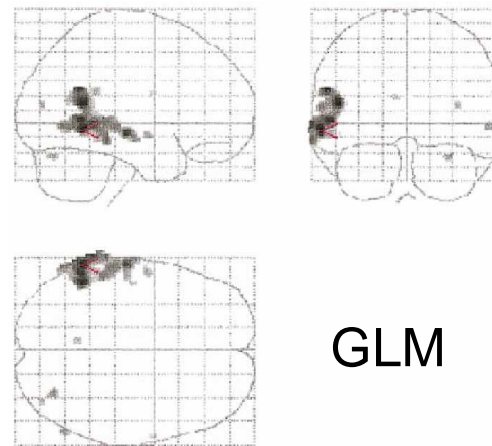


introduction information
temporelle EEG *a priori* dans
le modèle GLM en IRMf

EEG sous IRMf



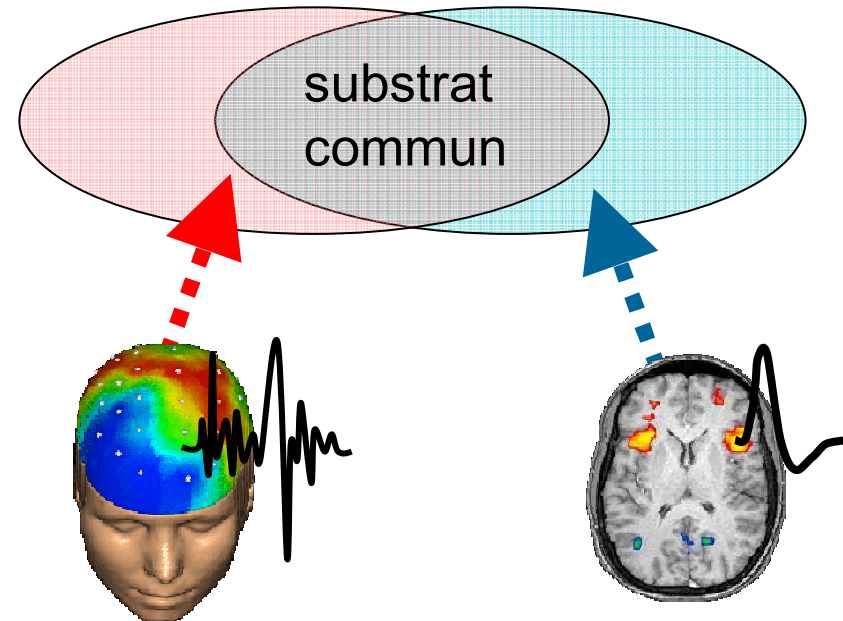
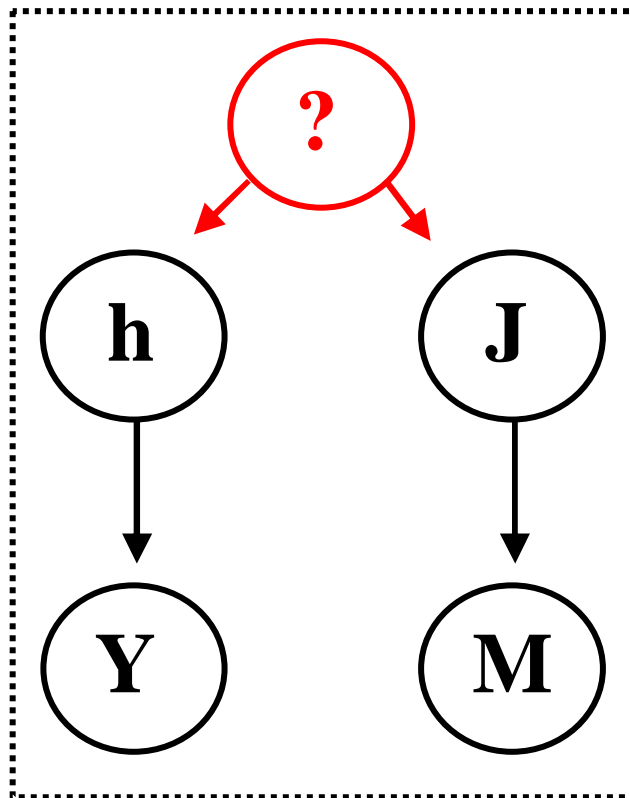
paradigme IRMf



GLM

fusion conjointe

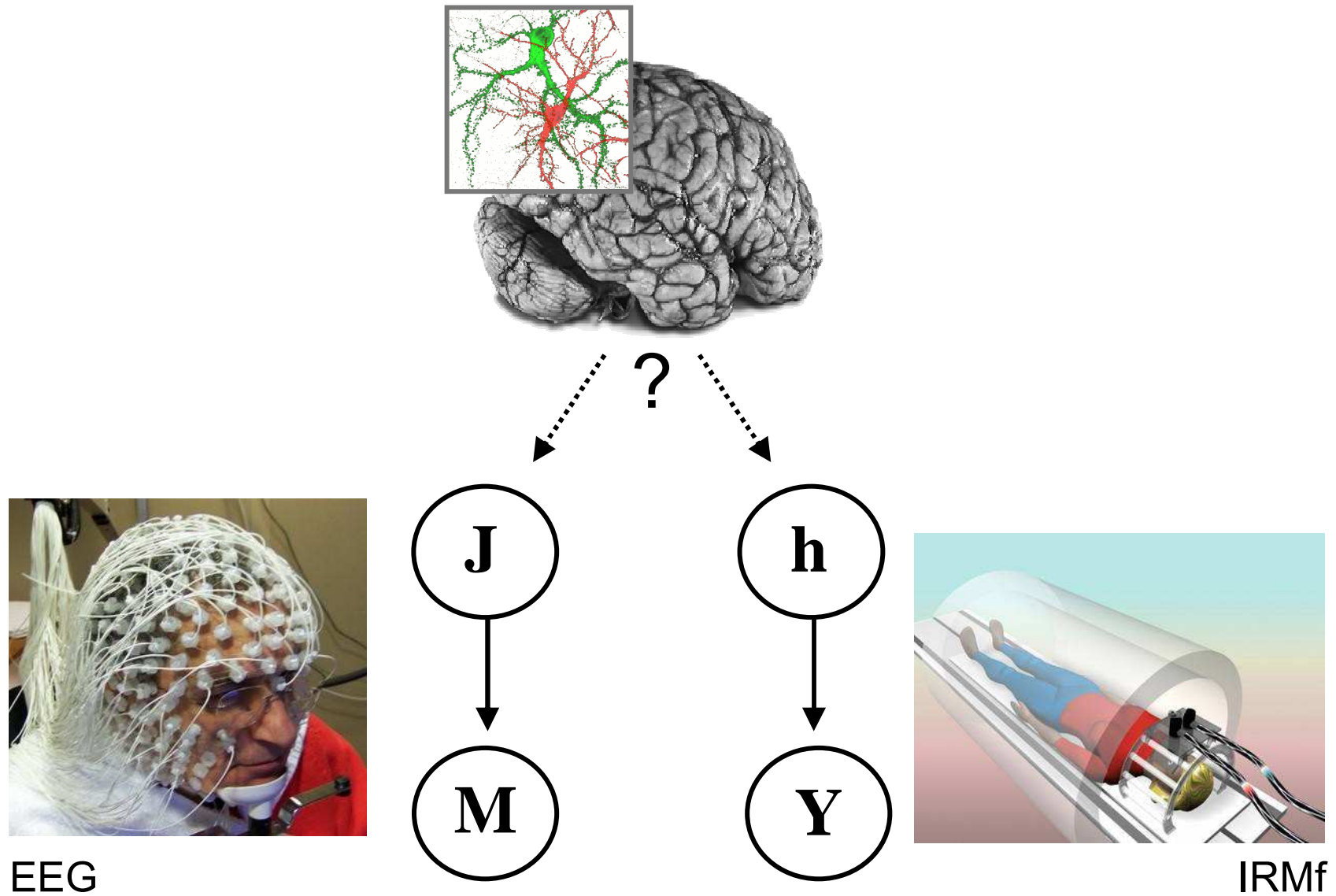
réduire l'incertitude sur la localisation et la dynamique des aires actives
bioélectriquement et hémodynamiquement



Pflieger et Greenblatt, 2001

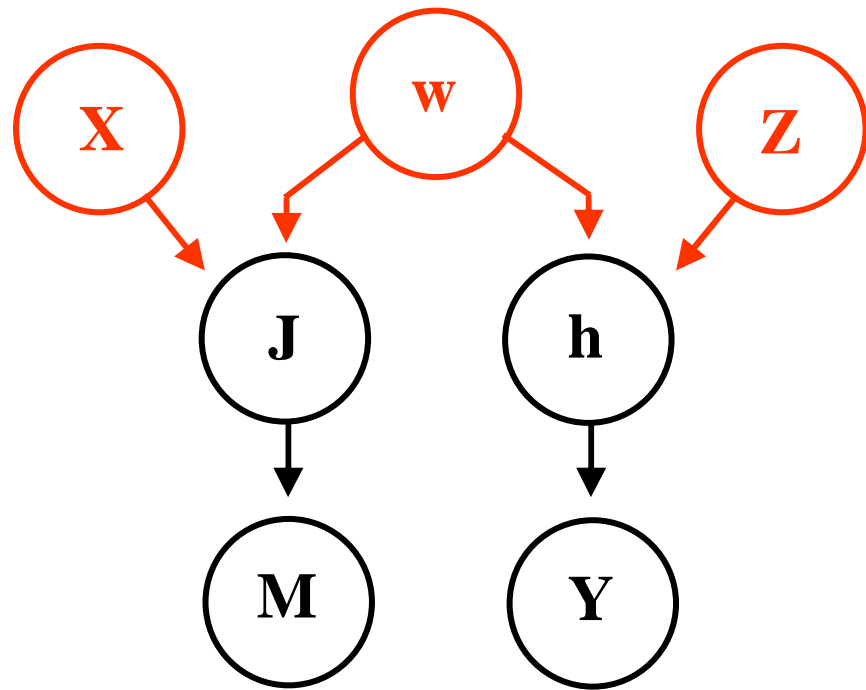
Fusion conjointe

modèle de réponses spatialement concordantes

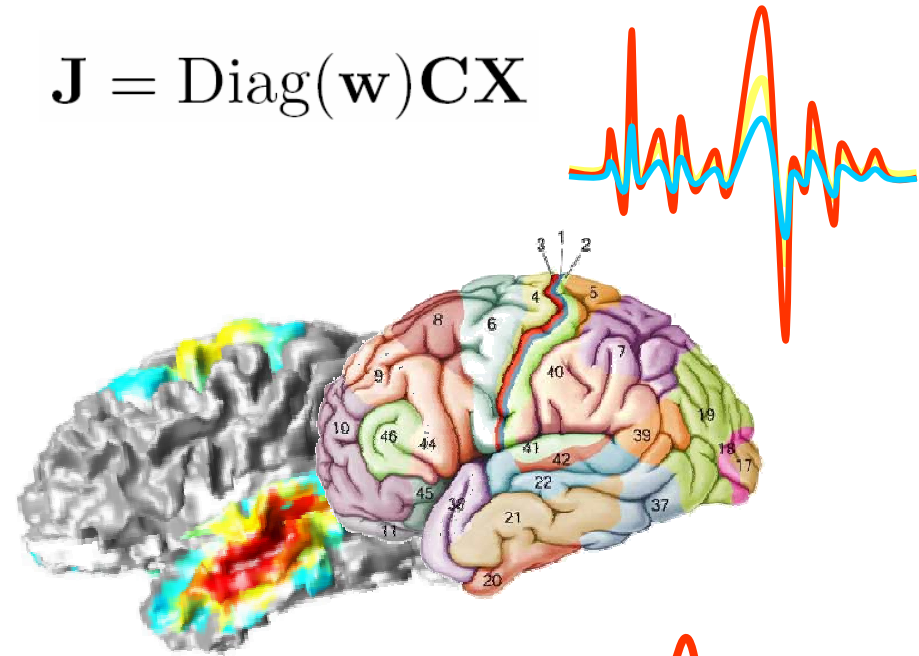


Fusion conjointe

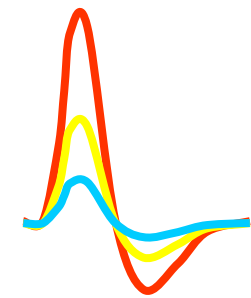
modèle de réponses spatialement concordantes



$$\mathbf{J} = \text{Diag}(\mathbf{w})\mathbf{C}\mathbf{X}$$

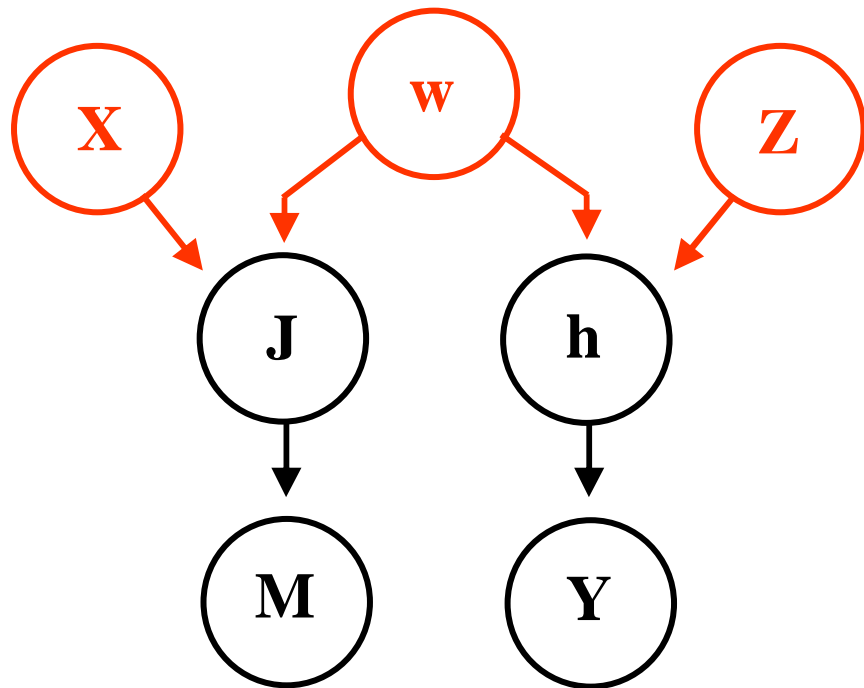


$$\mathbf{h} = \mathbf{Z}\mathbf{C}^T \text{Diag}(\mathbf{w})$$

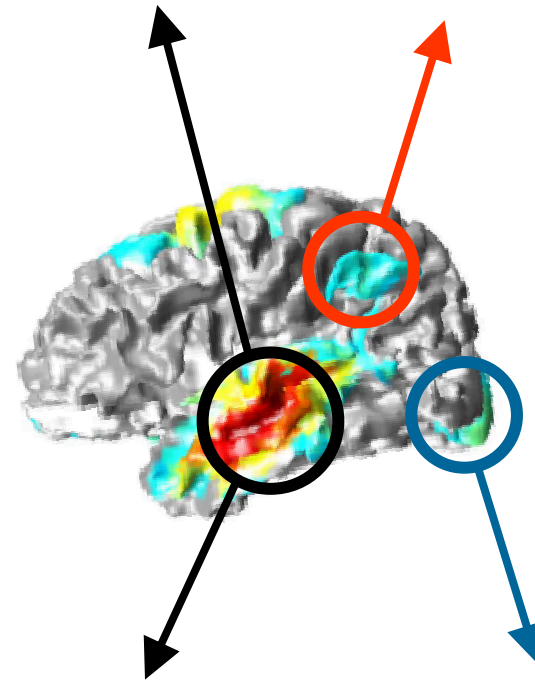


Fusion conjointe

modèle de réponses spatialement concordantes



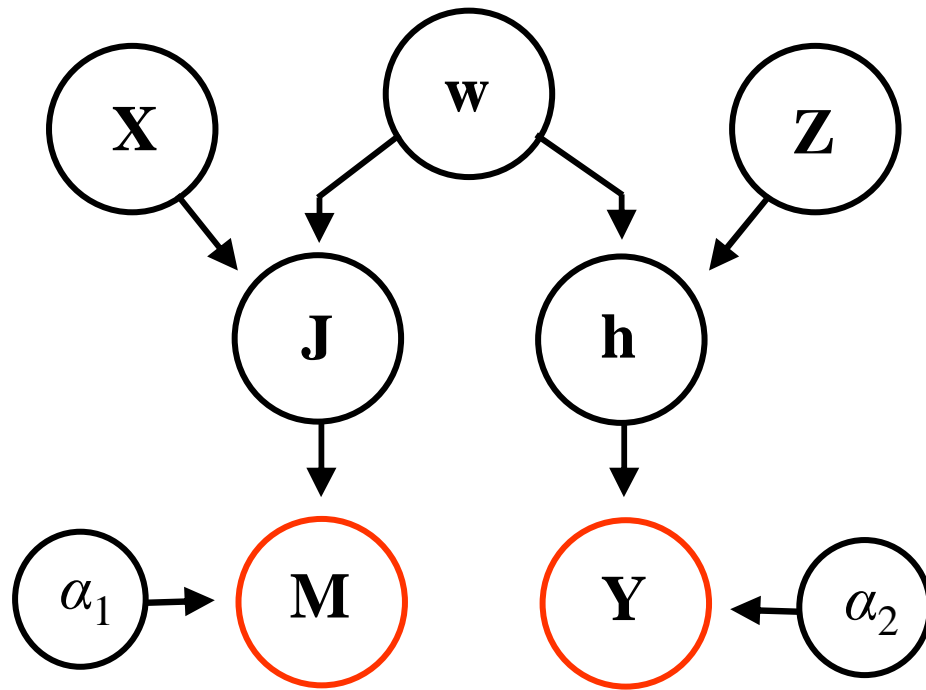
$$\mathbf{J} = \text{Diag}(\mathbf{w})\mathbf{C}\mathbf{X} + \mathbf{R}_{EEG}$$



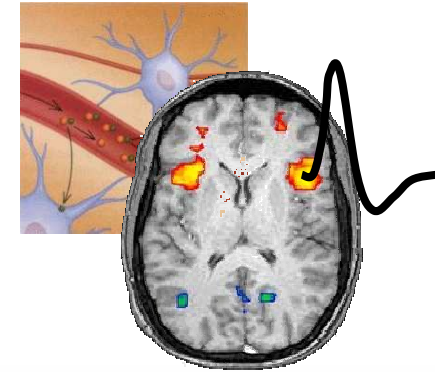
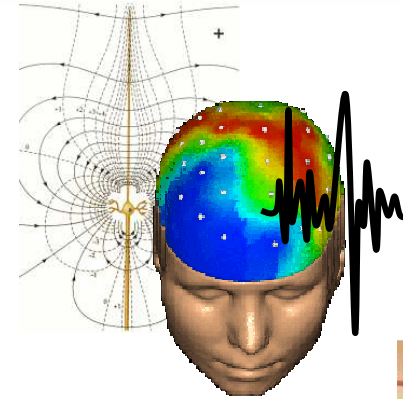
$$\mathbf{h} = \mathbf{Z}\mathbf{C}^T \text{Diag}(\mathbf{w}) + \mathbf{R}_{IRMf}$$

Fusion conjointe

modèle de réponses spatialement concordantes



$$\mathbf{M} = \mathbf{GJ} + \mathbf{E}$$

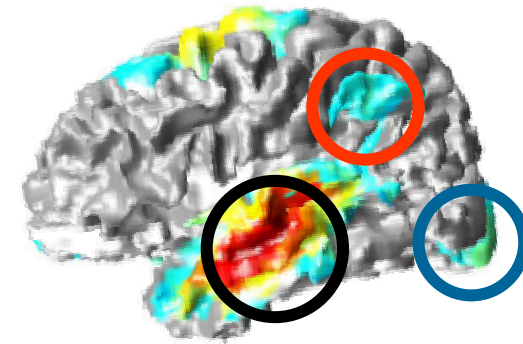
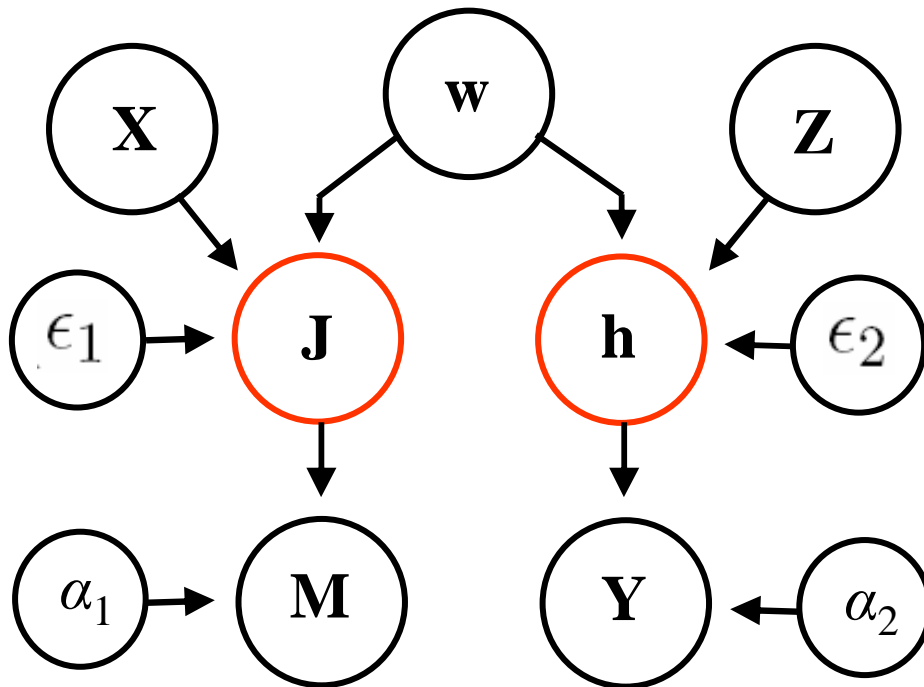


$$\mathbf{Y} = \mathbf{Bh} + \mathbf{F}$$

$$\begin{cases} p(\mathbf{M}|\mathbf{J}, \alpha_1, \mathcal{M}) = \prod_{i=1}^{t_1} \mathcal{N}\left(\mathbf{GJ}_i, \frac{1}{\alpha_1} \mathbf{I}_{pt_1}\right) \\ p(\mathbf{Y}|\mathbf{h}, \alpha_2, \mathcal{M}) = \prod_{j=1}^n \mathcal{N}\left(\mathbf{Bh}_j, \frac{1}{\alpha_2} \mathbf{I}_{nt_2}\right) \end{cases}$$

Fusion conjointe modèle de réponses spatialement concordantes

$$\mathbf{J} = \text{Diag}(\mathbf{w})\mathbf{C}\mathbf{X} + \mathbf{R}_{EEG}$$

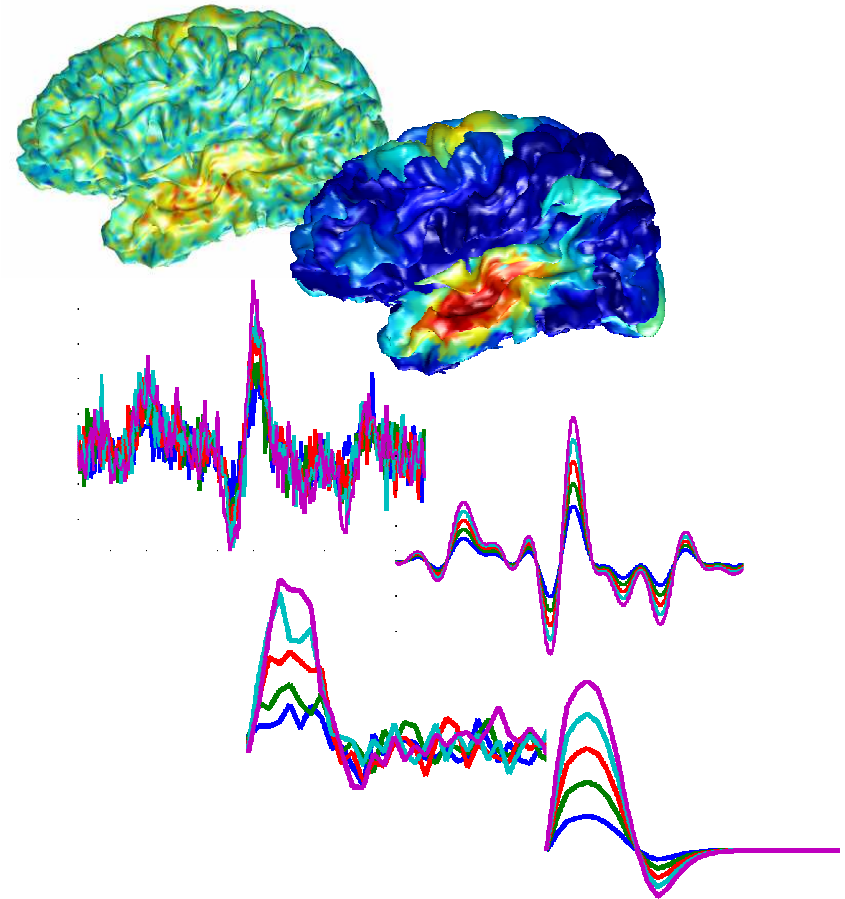
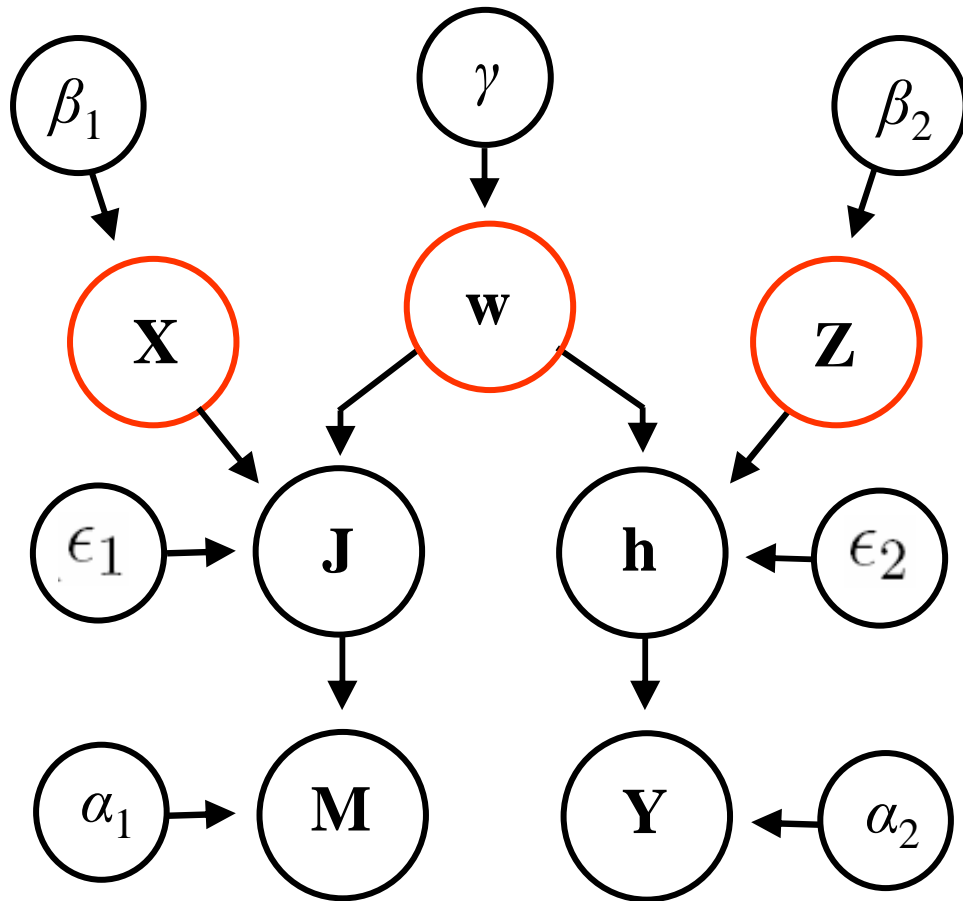


$$\mathbf{h} = \mathbf{Z}\mathbf{C}^T \text{Diag}(\mathbf{w}) + \mathbf{R}_{IRMf}$$

$$\begin{cases} p(\mathbf{J}|\mathbf{w}, \mathbf{X}, \epsilon_1, \mathcal{M}) = \prod_{i=1}^{t_1} \mathcal{N}\left(\mathbf{w}\mathbf{C}\mathbf{X}_i, \frac{1}{\epsilon_1}\mathbf{I}_n\right) \\ p(\mathbf{h}^*|\mathbf{w}, \mathbf{Z}^*, \epsilon_2, \mathcal{M}) = \prod_{j=1}^k \mathcal{N}\left(\mathbf{w}\mathbf{C}\mathbf{Z}_j^*, \frac{1}{\epsilon_2}\mathbf{I}_n\right) \end{cases}$$

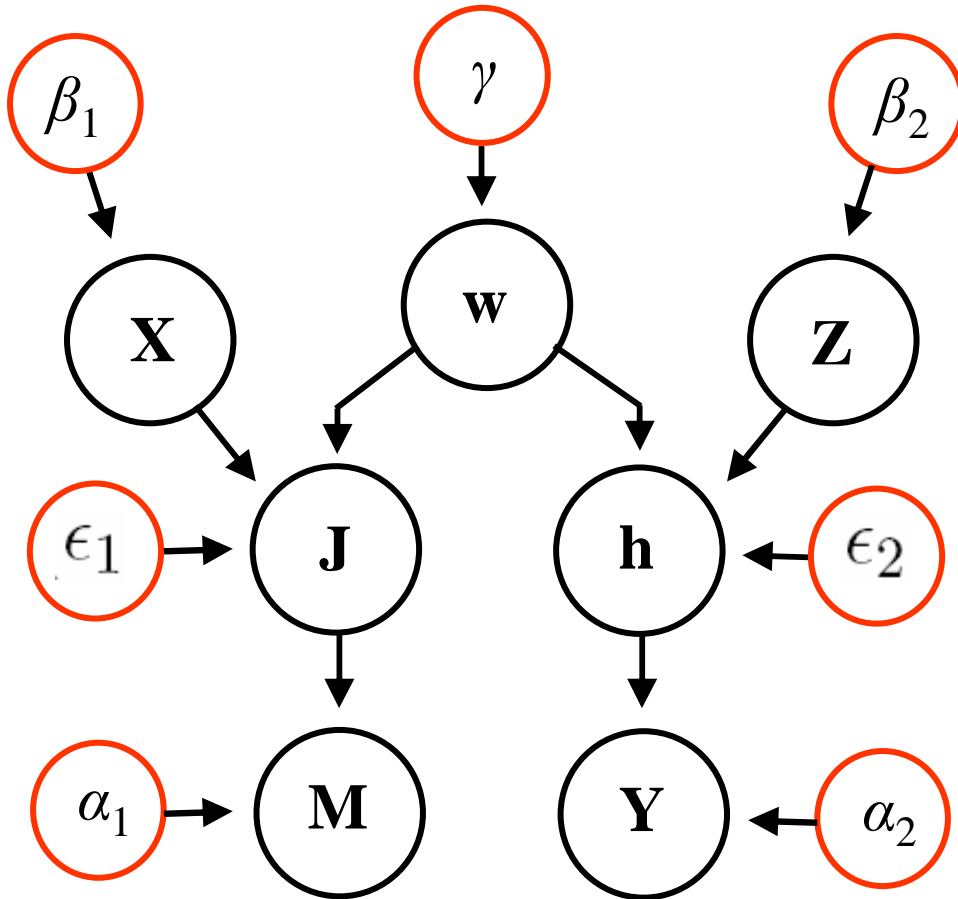
Fusion conjointe

modèle de réponses spatialement concordantes



$$\begin{cases} p(\text{vec}(\mathbf{X})|\beta_1, \mathcal{M}) = \mathcal{N}\left(\mathbf{0}_n, \frac{1}{\beta_1} (\mathbf{T}_1^\top \mathbf{T}_1)^{-1}\right) \\ p(\text{vec}(\mathbf{Z}^*)|\beta_2, \mathcal{M}) = \mathcal{N}\left(\mathbf{0}_n, \frac{1}{\beta_2} (\mathbf{T}_2^\top \mathbf{T}_2)^{-1}\right) \\ p(\mathbf{w}|\gamma, \mathcal{M}) = \mathcal{N}\left(\mathbf{0}_n, \frac{1}{\gamma} (\mathbf{S}^\top \mathbf{S})^{-1}\right) \end{cases}$$

Fusion conjointe modèle de réponses spatialement concordantes



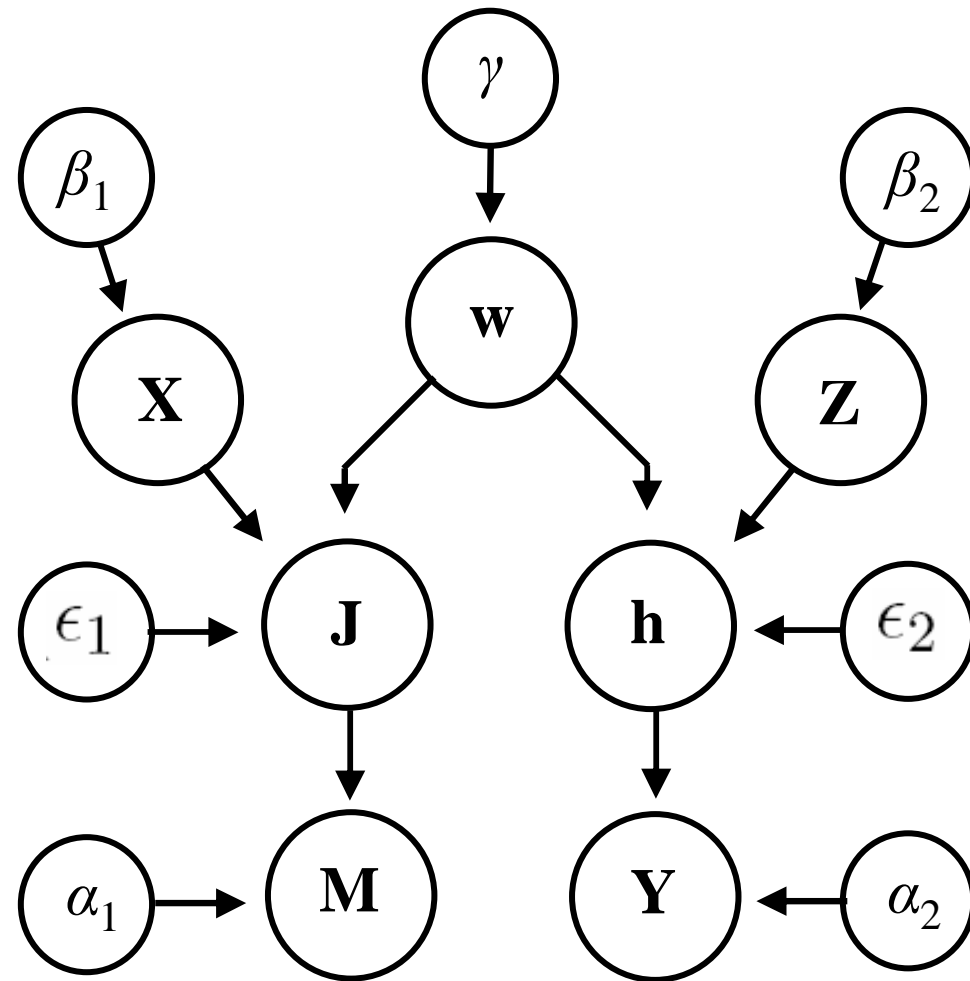
$$\begin{cases} p(\alpha_1 | \mathcal{M}) = \mathcal{G}(a_1, b_1) \\ p(\alpha_2 | \mathcal{M}) = \mathcal{G}(a_2, b_2) \end{cases}$$

$$\begin{cases} a_1 = \frac{pt_3}{2} & , b_1 = \frac{\text{tr}(\mathbf{M}_0^T \mathbf{M}_0)}{2} \\ a_2 = \frac{nt_4}{2} & , b_2 = \frac{\text{tr}(\mathbf{Y}_0^T \mathbf{Y}_0)}{2} \end{cases}$$

$$\begin{cases} p(\epsilon_1 | \mathcal{M}) \propto (\epsilon_1)^{-1} \\ p(\epsilon_2 | \mathcal{M}) \propto (\epsilon_2)^{-1} \\ p(\beta_1 | \mathcal{M}) \propto (\beta_1)^{-1} \\ p(\beta_2 | \mathcal{M}) \propto (\beta_2)^{-1} \\ p(\gamma | \mathcal{M}) \propto (\gamma)^{-1} \end{cases}$$

Fusion conjointe

modèle de réponses spatialement concordantes



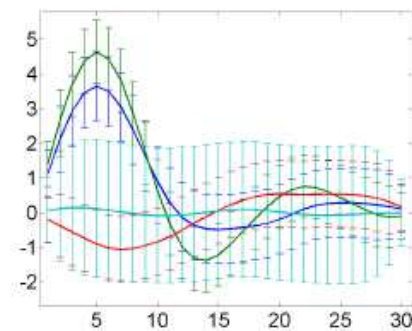
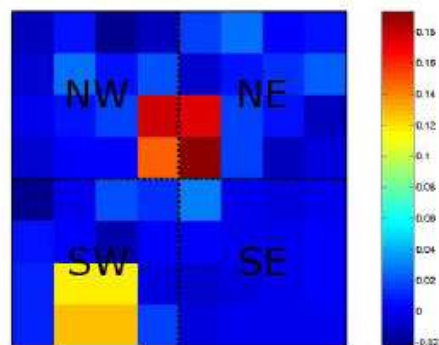
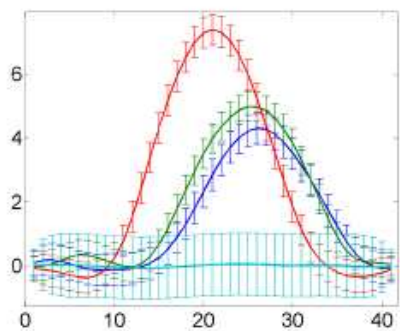
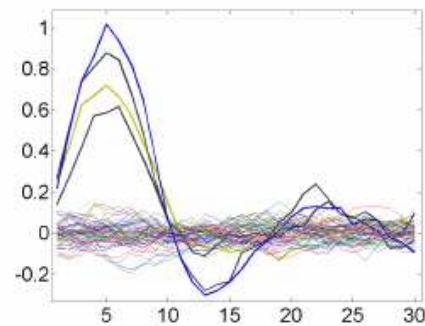
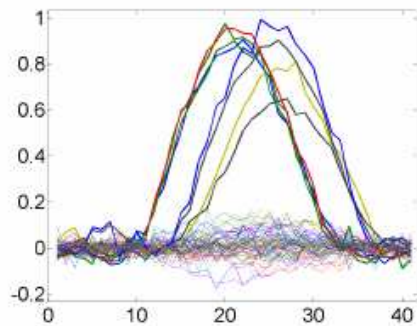
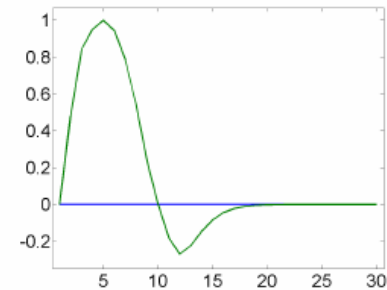
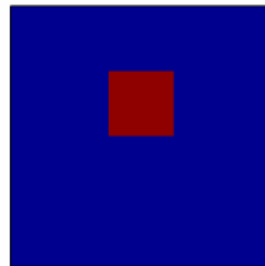
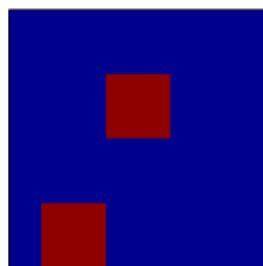
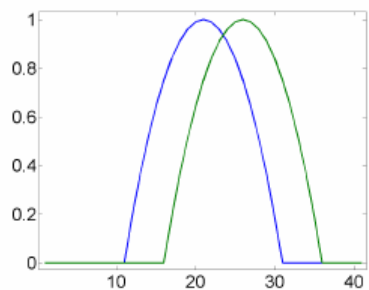
BASTERF
 Bayesian Spatio-Temporal
 Event-Related Fusion

Approximation
 variationnelle
 du champ
 moyen (VBEM)

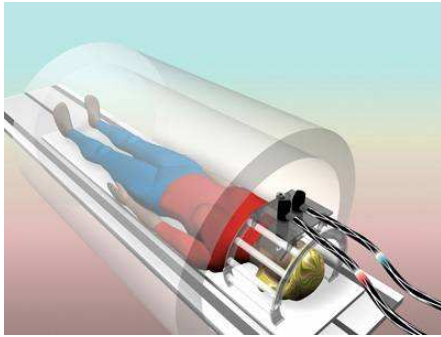
$$\begin{aligned}
 p(\mathbf{J}, \mathbf{h}, \mathbf{w}, \mathbf{X}, \mathbf{Z}, \boldsymbol{\theta} \mid \mathbf{M}, \mathbf{Y}, \mathcal{M}) &\propto p(\mathbf{M} \mid \mathbf{J}, \alpha_1, \mathcal{M}) p(\mathbf{Y} \mid \mathbf{h}, \alpha_2, \mathcal{M}) \\
 &\quad p(\mathbf{J} \mid \mathbf{w}, \mathbf{X}, \epsilon_1, \mathcal{M}) p(\mathbf{h} \mid \mathbf{w}, \mathbf{Z}, \epsilon_2, \mathcal{M}) \\
 &\quad p(\mathbf{w} \mid \gamma, \mathcal{M}) p(\mathbf{X} \mid \beta_1, \mathcal{M}) p(\mathbf{Z} \mid \beta_2, \mathcal{M}) p(\boldsymbol{\theta} \mid \mathcal{M})
 \end{aligned}$$

Fusion conjointe

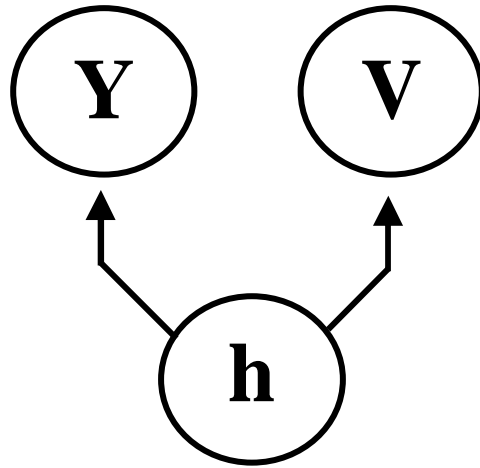
Exemple de simulation



Conclusions et perspectives



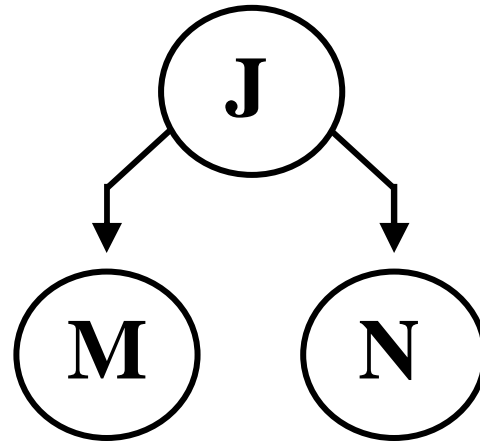
IRMf



imagerie
optique

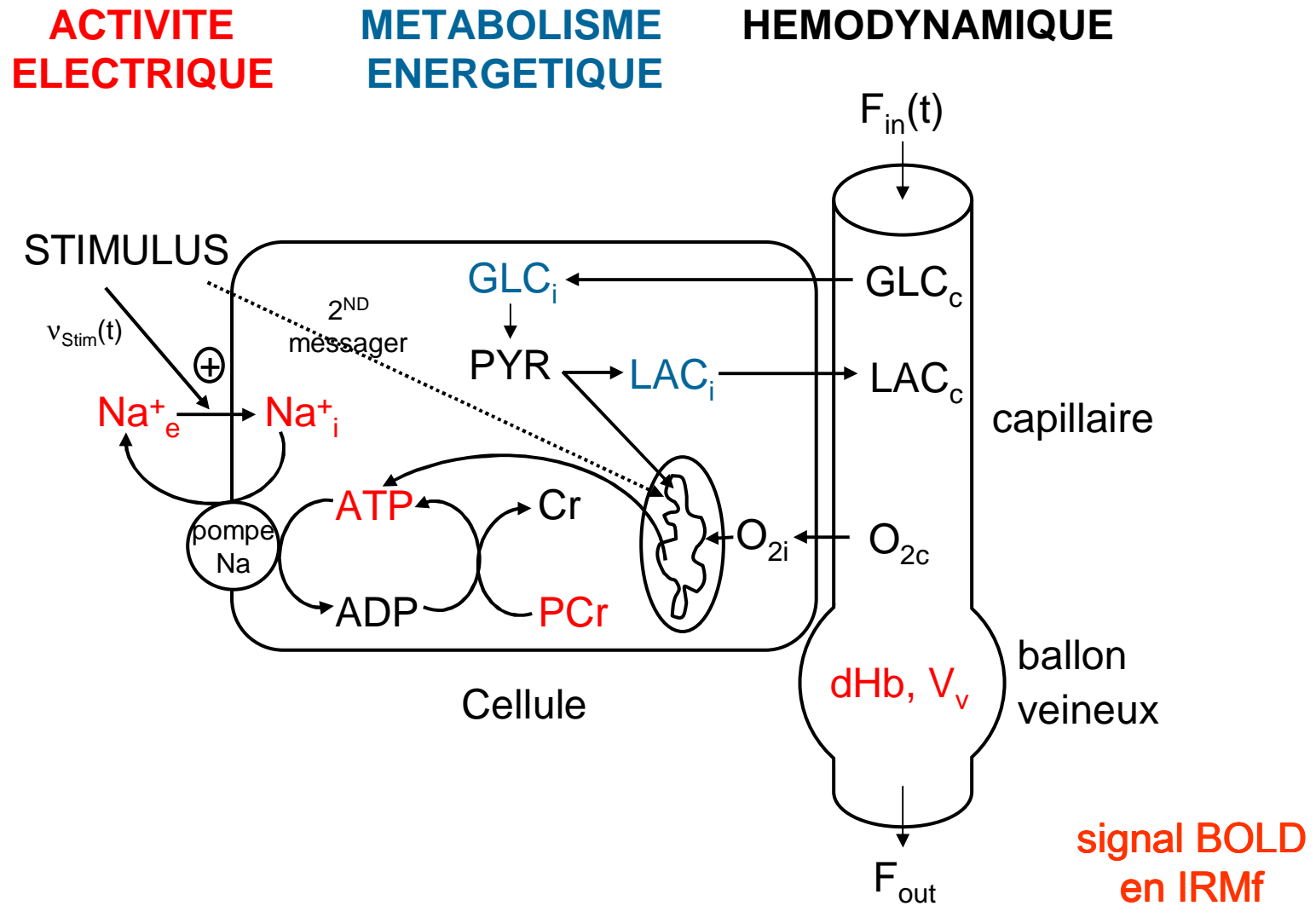


EEG



MEG

Conclusions et perspectives



Aubert et Costalat, 2002

Frison et al., 2003