Reconciling "priors" & "priors" without prejudice?

NIPS Spotlight

Rémi Gribonval Pierre Machart

INRIA
Centre de Rennes - Bretagne Atlantique

pierre.machart@inria.fr

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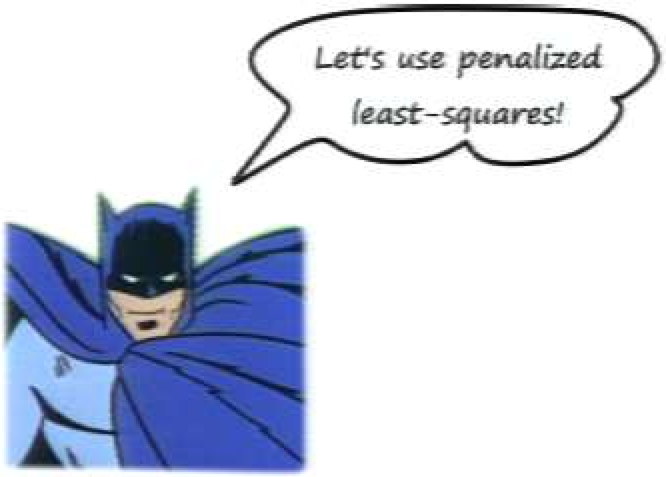
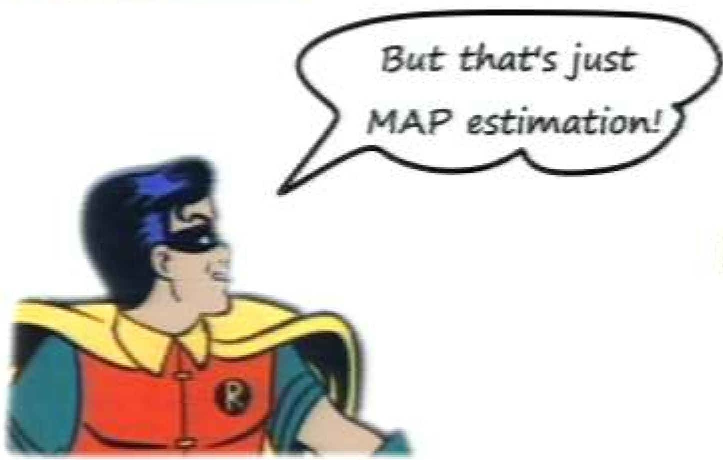
Motivation

Linear inverse problems: $y = \boldsymbol{A}z + b$, with Gaussian noise b



$$\operatorname{argmin}_z \tfrac{1}{2}\|y - \boldsymbol{A}z\|^2 + \phi(z) \qquad \text{(PLS)}$$

$$\Updownarrow$$



Maximum A Posteriori with prior $e^{-\phi(z)}$

Is (PLS) specifically cut for unknowns with distribution $e^{-\phi}$?

Main Results

$$\operatorname{argmin}_z \frac{1}{2}\|y - \boldsymbol{A}z\|^2 + \phi(z) \qquad \text{(PLS)}$$

Theorem (Flavor of the main result)

$\forall P_Z, \boldsymbol{A}$, $\exists \phi_{MMSE}$ s.t. the Minimum Mean Square Error estimator $\mathbb{E}(Z|Y = y)$, is the only minimizer of (PLS)

Corollary (On the multiple valid interpretations)

For a large class of penalties ϕ,

MAP with prior $P_{MAP} \propto \exp(-\phi(z)) \Leftrightarrow$ (PLS) $\Leftrightarrow$ MMSE with prior $P_{MMSE} \neq P_{MAP}$

$\Rightarrow$ choosing a regularizer $\phi \neq$ designing for a specific P_Z!

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