

#### Effective Source Clustering





#### Largest 30 independent components (single subject)



Makeig, 2007

## Why cluster independent components across subjects or sessions?



- ICA transforms the data from a channel basis (activity recorded at each channel)
  - to a component basis (activity computed at each IC).
- Normally, EEG researchers assume that electrode, say channel F7 == F7 == F7 ... in each subject and then 'cluster' their data ["Your Cz = My Cz."]
- But this is only *roughly* correct!



#### **Seond Subject**



#### **Third Subject**



#### **Fourth Subject**





EEGLAB Workshop 16, June, 2013, Aspet, France: Scott Makeig – CompSnMakeige&nM. Miyakoshi, 2015

#### A FM-theta cluster during working memory

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#### So how to cluster components?

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#### The same problems hold for clustering independent components

Across Ss, components don't even have "the same" scalp maps!

 $\rightarrow$  Are "the same" components found across subjects?

- What should define "the same" (i.e., "component equivalence")?
  - Similar scalp maps?
  - Similar cortical or 3-D equivalent dipole locations?
  - Similar activity power spectra?
  - Similar ERPs?
  - Similar ERSPs?
  - Similar ITCs?
  - Or similar *combinations* of the above?? ...

#### **EEG IC Source Locations**

#### (135,794 IC equivalent dipoles)





Nima Bigdely-Shamlo, Kay Robbins, Christian Kothe, Jessica His, Scott Makeig, 2013





Does the spatial distribution of IC equivalent dipole source locations depend on the task the subject performs?

i.e.

Do "the same" ICs (& IC clusters) appear for every task?



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Onton et al., 2



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Onton et al., 2

Onton et al., '05



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#### Equivalent dipole density Exp I



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Onton et al., 2

Onton et al., '05

#### Equivalent dipole density Exp II



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### **Study IC Clustering**

![](_page_19_Picture_1.jpeg)

![](_page_19_Picture_2.jpeg)

![](_page_19_Picture_3.jpeg)

Onton & Makeig, 2007

# Problems with multi-measure clustering

What are the clusters according to location?

![](_page_20_Picture_2.jpeg)

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# Problems with multi-measure clustering

#### What are the clusters according to size ?

![](_page_21_Picture_2.jpeg)

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# Problems with multi-measure clustering

What are the clusters according to location and size?

Well, it depends on how much weight we give each

![](_page_22_Picture_3.jpeg)

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#### **Measure Projection: RSVP Example**

#### Project Target ERSPs on Equivalent Dipole Locations

![](_page_23_Picture_2.jpeg)

![](_page_23_Picture_3.jpeg)

N. Bigdely-Shamlo, 2011

#### **Measure Projection: RSVP Example**

![](_page_24_Picture_1.jpeg)

#### Effects of skull conductivity mis-estimation

![](_page_25_Figure_1.jpeg)

![](_page_26_Figure_0.jpeg)

Zeynep Akalin Acar & Scott Makeig '06

**EEG/MEG** 

![](_page_27_Figure_0.jpeg)

A. Akalin Acar, C. Acar & S. Makeig, 2015

![](_page_28_Figure_0.jpeg)

A. Akalin Acar, C. Acar & S. Makeig, 2015

#### **High-resolution source localization**

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### **Questions?**

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