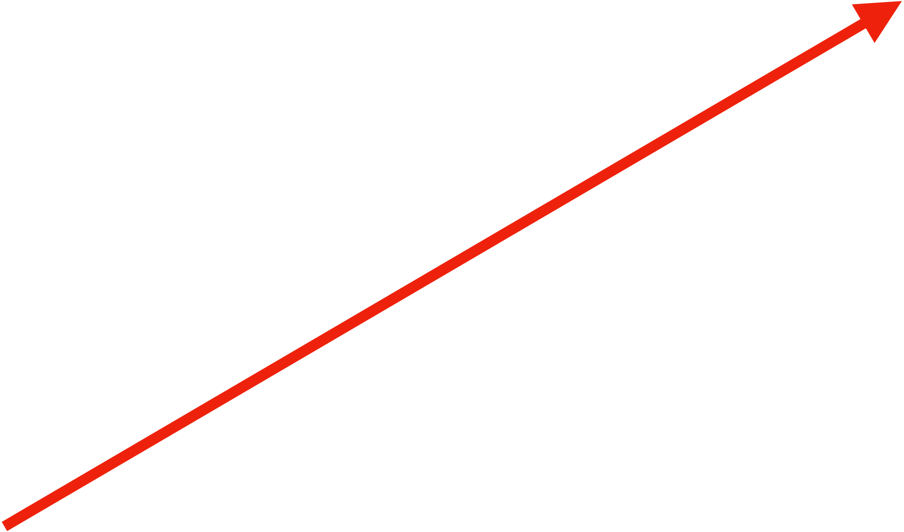
Choose $\mathbf{a}_i \overset{iid}{\sim} \mathcal{N}(\mathbf{0}, \mathbf{I}_D)$

Sensing matrices take the form

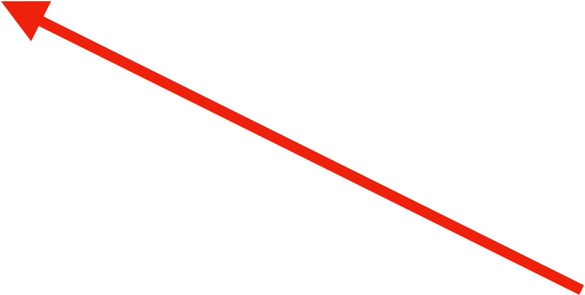
$$\frac{y + \eta_i}{\mathbf{a}_i^\top \mathbf{M} \mathbf{a}_i} \mathbf{a}_i \mathbf{a}_i^\top$$

Learning from PAQs: challenges

Sensing matrix depends on noise! Results in biased estimators

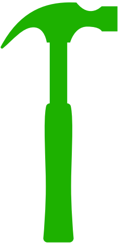


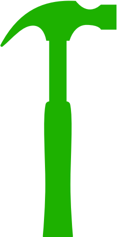
Inverse Chi-Square term makes the sensing matrices heavy-tailed!



Heavy-tail mitigation with **truncation**

Bias elimination with **averaging**





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Learning from PAQs: challenges

Choose $\mathbf{a}_i \overset{iid}{\sim} \mathcal{N}(\mathbf{0}, \mathbf{I}_D)$

Sensing matrices take the form

$$\frac{\boxed{y + \eta_i}}{\boxed{\mathbf{a}_i^\top \mathbf{M} \mathbf{a}_i}} \mathbf{a}_i \mathbf{a}_i^\top$$

Sensing matrix depends on noise! Results in biased estimators

Inverse Chi-Square term makes the sensing matrices heavy-tailed!

Bias elimination with **averaging**

Heavy-tail mitigation with **truncation**

A nuclear norm regularized estimator

For each of the n query vectors $\mathbf{a}_i$:

- **Bias elimination:** Collect m PAQ responses $\gamma_{i_1}, \ldots, \gamma_{i_m}$ and form *averaged response* $\bar{\gamma}_i^2 = \frac{1}{m} \sum_{j=1}^{m} \gamma_{i_j}^2$

- **Heavy-tail mitigation:** Truncate the averaged response by some value τ. Form *shrunken response* $\tilde{\gamma}_i^2 = \min\{\bar{\gamma}_i^2, \tau\}$

- Form *shrunken sensing matrix* $\widetilde{\mathbf{A}}_i = \tilde{\gamma}_i^2 \mathbf{a_i} \mathbf{a_i}^\top$