h_s & h_m : DIFFERENT CASES & OUTPUTS

→ In section 2.3 of direct computation paper, we compute H_S & H_M as follows

$$H_M = \begin{bmatrix} h_m^T \\ 0 \quad I \end{bmatrix} \; ; \; H_S = \begin{bmatrix} I & h_s \\ 0 & \end{bmatrix}^{-1}$$

$$\Downarrow \qquad\qquad\qquad\qquad \Downarrow$$

$$\underbrace{h_m^T \hat{M}_j = 1}_{\text{To compute } h_m} \qquad\qquad \underbrace{h_s^T \hat{S}_i = 1}_{\text{To compute } h_s.}$$

→ In paper, It is stated that, to remain the first row of $H_M \hat{M}_j$ unchanged, first element of h_s has to be zero.

because,

$$S_i^T M_j = \hat{S}_i H^{-1} H \hat{M}_j$$

$$= \hat{S}_i^T H_M^{-1} \underline{H_S^{-1}} H_Q^{-1} H_Q H_S \underline{\underline{H_M \hat{M}_j}}$$

$$\begin{bmatrix} I & h_s \\ 0 & \end{bmatrix} \cdots \begin{bmatrix} | & | & | & | \\ - & - & & \\ - & - & & \\ - & & & \end{bmatrix}$$

∴ First element has to be zero, to avoid changing 1st row of $H_M \hat{M}_j$'

→ But there is also other observation, i.e., last element of hm should be zero as well to ~~remain~~ avoid changing last column of $\hat{S}_i^T$, because

$$S_i^T M_j = \hat{S}_i^T H^{-1} H \hat{M}_j$$

$$= \underline{\underline{\hat{S}_i^T}} H_m^{-1} H_S^{-1} H_Q^{-1} H_Q H_S \underline{\underline{H_M}} \hat{M}_j$$

$$\begin{bmatrix} - & - & - & | \\ - & - & & | \\ - & - & & | \\ - & & & | \end{bmatrix} \cdots \begin{bmatrix} & h_m^T \\ 0 & I \end{bmatrix}$$

∴ Last element of h_m^T has to be '0' to avoid changing last column of $\underline{\underline{\hat{S}_i^T}}$.

→ on this observation, I considered different cases & compared their o/ps. & those cases ~~are~~ are:

i) Including hs constraint & excluding hm constraint (the one in paper)

ii) Incl. hs, Incl. hm

iii) excl. hs, Incl. hm

iv) excl hs, excl. hm.

→ The o/ps for these cases are based on "direct-comp-papers-script1", where we calculate the total relative error, part-by-part rel. errors w.r.t true EDMs., & following are the observations.

① 1 Source, 4 virtual sources, 8 Mics

S = 340*[3 2]

M = 340*[1 6; 2 5; 4 5; 4 4; 5 1; 6 6; 7 1; 7 3]

Ti = [2; 2; 2; 2; 2].

Cases	Total Rel. error	mic-mic rel. error	Sour-mic rel. error	Sour-Sour Rel. error
S X	0.4158	0.7500	0.5814	2.8×10^{-15}
S M	0.4257	0.6806	0.5826	0.1441
X M	24.1669	0.9881	33.2367	11.8152
X X	24.1672	0.9881	33.2371	11.8154

Rounded ones – lower values.

& In ~~XM~~ (X M) & (X X) case, Qmid is not PSD; so not valid.

② 1 Source, 4 V.S, 12 Mics

S = 340*[3 2]

M = 340*[1 6; 2 5; 4 5; 4 4; 5 1; 6 6; 7 1; 7 3; 1 1; 2 2; 5 7; 7 5]

Ti = [2; 2; 2; 2; 2].

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Cases	Total Rel. error	Mic-Mic Rel. error	Sour-Mic part Rel. error	Sour-Sour "
S X	0.4853	0.7500	0.6043	3×10^{-15}
S M	0.4973	0.6764	0.6086	0.1965

(X M), (X X) → In Valid cases.

(3) 1 Source, 4 V.S, 16 Mics

Same S, VS, M as in case (2) + 4 Mics
[1 4; 2 7; 5 5; 6 3]

Cases	Total Rel. error	Mic-Mic "	Sour-Mic "	Sour-Sour "
S X	0.5088	0.7500	0.5981	1.2×10^{-15}
S M	0.5146	0.6789	0.6010	0.1911

(X, M), (X X) → Invalid Cases

Conclusion:

i, (S X), (S M) are the only valid cases, & for any no. of mics, Total Rel. error is less for (S X) [the one proposed in paper], but (S M) is estimating the Mic-mic part of the EDM well (less Rel. error).

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