Research on Google's Monet

Style Data (Since Android 13 Beta 3)

STYLE	ATTRIBUTE	A1	A2	A3	N1	N2
TONAL SPOT	Chroma	36	16	24	4	8
	Hue shift			$+60°$		
SPRITZ	Chroma	12	8	16	2	2
	Hue shift			$+30°$		
VIBRANT	Chroma	48	24	32	10	12
	Hue shift		[1]	[2]		
EXPRESSIVE	Chroma	40	24	32	15	12
	Hue shift	$+240°$	[3]	[4]	$+15°$	$+15°$
CONTENT	Chroma	$\times 1$	$\times \frac{1}{3}$	$\times \frac{2}{3}$	$\times \frac{1}{12}$	$\times \frac{1}{6}$
	Hue shift					

HUE ROTATION

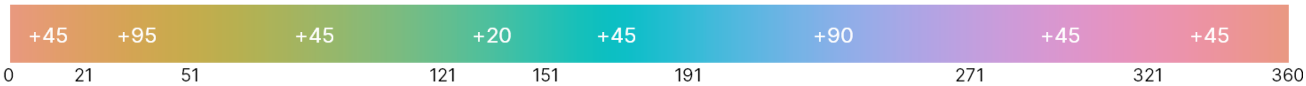
[1]	(0,18)	(41,15)	(61,10)	(101,12)	(131,15)	(181,18)	(251,15)	(301,12)	(360,12)
[2]	(0,35)	(41,30)	(61,20)	(101,25)	(131,30)	(181,35)	(251,30)	(301,25)	(360,25)
[3]	(0,45)	(21,95)	(51,45)	(121,20)	(151,45)	(191,90)	(271,45)	(321,45)	(360,45)
[4]	(0,120)	(21,120)	(51,20)	(121,45)	(151,20)	(191,15)	(271,20)	(321,120)	(360,120)

Hue baseline

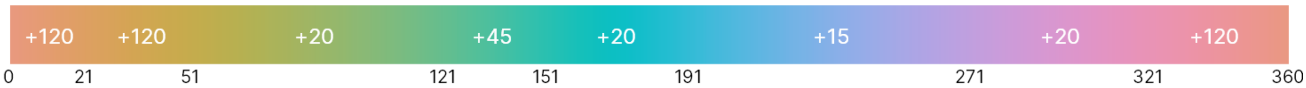
Vibrant secondary hue rotation

Vibrant tertiary hue rotation

Expressive secondary hue rotation



Expressive tertiary hue rotation



Appendices

Appendix A: The Simplified CAM16 Model

Define

$$F = 3.88481453780035 29E-3$$
$$R = 29.482183021342301$$
$$d = 1.3173270022537199$$

$$M_{16} \equiv \begin{pmatrix} 0.401288 & 0.650173 & -0.051461 \\ -0.250268 & 1.204414 & 0.045854 \\ -0.002079 & 0.048952 & 0.953127 \end{pmatrix}$$

$$\boldsymbol{D} \equiv \begin{pmatrix} 1.0211774459482703 \\ 0.98630789117685210 \\ 0.93396137406301061 \end{pmatrix}$$

$$\Re \equiv \begin{pmatrix} 2 & 1 & \frac{1}{20} \\ 1 & -\frac{12}{11} & \frac{1}{11} \\ \frac{1}{9} & \frac{1}{9} & -\frac{2}{9} \end{pmatrix}$$

$$\mathcal{F}(\boldsymbol{v}) \equiv \left\{ 400 \operatorname{sign}(\boldsymbol{v}_i) \frac{(F\boldsymbol{v}_i)^{0.42}}{(F\boldsymbol{v}_i)^{0.42} + 27.13} \right\}$$

$$\mathcal{F}^{-1}(\boldsymbol{v}) \equiv \left\{ \frac{\operatorname{sign}(\boldsymbol{v}_i)}{F} \left(\frac{27.13|\boldsymbol{v}_i|}{400 - |\boldsymbol{v}_i|} \right)^{\frac{1}{0.42}} \right\}$$

$$\begin{aligned} \varepsilon(h) \equiv 1 &- 0.0582 \cos h - 0.0258 \cos 2h \\ &- 0.1347 \cos 3h + 0.0289 \cos 4h \\ &- 0.1475 \sin h - 0.0308 \sin 2h \\ &+ 0.0385 \sin 3h + 0.0096 \sin 4h \end{aligned}$$

From CIE XYZ to CAM16

Input: CIE XYZ vector $\boldsymbol{X}$
Output: CAM16 (JCh) vector $\boldsymbol{M}$

$$\begin{pmatrix} A \\ a \\ b \end{pmatrix} = \Re\mathcal{F}(\mathrm{Diag}(\boldsymbol{D})M_{16}\boldsymbol{X})$$

$$h' = \arctan\left(\frac{b}{a}\right)$$

$$\boldsymbol{M} = \begin{pmatrix} 100\left(\frac{A}{R}\right)^d \\ \frac{1505}{R}\varepsilon(h')\sqrt{a^2+b^2} \\ \frac{180^\circ}{\pi}h' \end{pmatrix}$$

From CAM16 to CIE XYZ

Input: CAM16 (JCh) vector $(J, C, h)^T$
Output: CIE XYZ vector $\boldsymbol{X}$

$$h' = \frac{\pi}{180^\circ}h$$

$$\gamma = \frac{C}{1505\,\varepsilon(h')}$$

$$\boldsymbol{X} = M_{16}^{-1}\mathrm{Diag}(\boldsymbol{D}^{\circ -1})\mathcal{F}^{-1}\left(\Re^{-1}R \begin{pmatrix} \left(\frac{J}{100}\right)^{\frac{1}{d}} \\ \gamma \cos h' \\ \gamma \sin h' \end{pmatrix} \right)$$

Notes on Appendix A

1. All the numbers were rounded to 17 significant digits (which was done in the last steps, but the intermediate values were arithmetically exact) except those defined in specifications.

2. The inverse of M_{16}

$$M_{16}^{-1} \equiv \begin{pmatrix} 1.8620678550872327 & -1.0112546305316844 & 0.14918677544445172 \\ 0.38752654323613716 & 0.62144744193147536 & -0.0089739851676125183 \\ -0.015841498849333855 & -0.034122938028515564 & 1.0499644368778494 \end{pmatrix}$$

3. The reference white $\boldsymbol{W}_{\mathrm{D65}}$ used throughout the calculation

$$\boldsymbol{W}_{\mathrm{D65}} \equiv \begin{pmatrix} 95.047055865428191 \\ 100 \\ 108.88287363958874 \end{pmatrix}$$

4. The Hadamard inverse (of a vector)

$$(\boldsymbol{v}^{\circ -1})_i = \frac{1}{\boldsymbol{v}_i}$$

Appendix B: Conversions between CIE XYZ and sRGB

$$M \equiv 100 \begin{pmatrix} 0.41245744558236514 & 0.35757586524551642 & 0.18043724782640035 \\ 0.21267337037840703 & 0.71515173049103283 & 0.072174899130560142 \\ 0.019333942761673366 & 0.11919195508183881 & 0.95030283855237520 \end{pmatrix}$$

$$M^{-1} \equiv \frac{1}{100} \begin{pmatrix} 3.2404462546477561 & -1.5371347618200895 & -0.49853019302273171 \\ -0.96926660624467829 & 1.8760119597883673 & 0.041556042214430008 \\ 0.055643503564352598 & -0.20402617973595953 & 1.0572265677226994 \end{pmatrix}$$

$$\mathcal{F}(\boldsymbol{v}) \equiv \left\{ \begin{cases} \left(\dfrac{\boldsymbol{v}_i + 0.055}{1.055}\right)^{2.4}, & \boldsymbol{v}_i \geq \dfrac{11}{280} \\ \dfrac{\boldsymbol{v}_i}{12.923210180787861}, & otherwise \end{cases} \right\}$$

$$\mathcal{F}^{-1}(\boldsymbol{v}) \equiv \left\{ \begin{cases} 1.055\, \boldsymbol{v}_i^{\frac{1}{2.4}} - 0.055, & \boldsymbol{v}_i \geq 0.0030399346397784300 \\ 12.923210180787861\, \boldsymbol{v}_i, & otherwise \end{cases} \right\}$$

From sRGB to CIE XYZ

Input: sRGB vector $\boldsymbol{R}$
Output: CIE XYZ vector $\boldsymbol{X}$

$$\boldsymbol{X} = M\mathcal{F}(\boldsymbol{R})$$

From CIE XYZ to sRGB

Input: CIE XYZ vector $\boldsymbol{X}$
Output: sRGB vector $\boldsymbol{R}$

$$\boldsymbol{R} = \mathcal{F}^{-1}(M^{-1}\boldsymbol{X})$$