Supplementary Text, Tables, and Figures

1. Sequence design

- Y-shaped DNA nanostructures (Y-motifs)

In the following tables, sticky ends (SEs) are marked by bold fonts. Sequences marked in the same color form a double-stranded stem.

Supplementary Table 1 Y-motif without azobenzene (Y)

Name	Sequence (5′–3′)
Y-1	**GCTCGAGC**CAGTGAGGACGGAAGT**TT**GTCGTAGCATCGCACC
Y-2	**GCTCGAGC**CAACCACGCCTGTCCA**TT**ACTTCCGTCCTCACTG
Y-3	**GCTCGAGC**GGTGCGATGCTACGAC**TTT**GGACAGGCGTGGTTG

Sequences were referenced from Y. Sato *et al.* (2020).

Supplementary Table 2 Y-motif with azobenzene (Y_{1x7})

Name	Sequence (5′–3′)
Y_{1x7}-1	**GxCTCGAGC**...
Y_{1x7}-2	**GxCTCGAGC**...
Y_{1x7}-3	**GxCTCGAGC**...

Azobenzene (‘x’) was inserted in the SEs of Y. Stem sequences (...) were the same as the counterparts of Y.

Supplementary Table 3 Y-motif with azobenzene (Y_{3x5})

Name	Sequence (5′–3′)
Y_{3x5}-1	**GCTxCGAGC**...
Y_{3x5}-2	**GCTxCGAGC**...
Y_{3x5}-3	**GCTxCGAGC**...

Supplementary Table 4 Y-motif with azobenzene (Y_{2x1x5})

Name	Sequence (5′–3′)
Y_{2x1x5}-1	**GCxTxCGAGC**...
Y_{2x1x5}-2	**GCxTxCGAGC**...
Y_{2x1x5}-3	**GCxTxCGAGC**...

Supplementary Table 5 Y-motif with azobenzene (Y_{2x4})

Name	Sequence (5′–3′)
Y_{2x4}-1	GCxTAGC...
Y_{2x4}-2	GCxTAGC...
Y_{2x4}-3	GCxTAGC...

Supplementary Table 6 Y-motif with a single SE (Control)

Name	Sequence (5′–3′)
Y′-1	(The same as Y-1)
Y′-2	CAACCACGCCTGTCCATTACTTCCGTCCTCACTG
Y′-3	GGTGCGATGCTACGACTTTGGACAGGCGTGGTTG

Supplementary Table 7 Azobenzene-tethered Y-motif with a single SE (SE_{1x7})

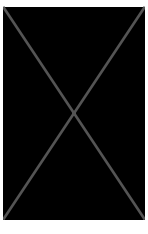
Name	Sequence (5′–3′)
Y'_{1x7}-1	(The same as Y_{1x7}-1)
Y'_{1x7}-2	(The same as Y′-2)
Y'_{1x7}-3	(The same as Y′-3)

Supplementary Table 8 Azobenzene-tethered Y-motif with a single SE (SE_{3x5})

Name	Sequence (5′–3′)
Y'_{3x5}-1	(The same as Y_{3x5}-1)
Y'_{3x5}-2	(The same as Y′-2)
Y'_{3x5}-3	(The same as Y′-3)

Supplementary Table 9 Azobenzene-tethered Y-motif with a single SE (SE_{2x1x5})

Name	Sequence (5′–3′)
Y'_{2x1x5}-1	(The same as Y_{2x1x5}-1)
Y'_{2x1x5}-2	(The same as Y′-2)
Y'_{2x1x5}-3	(The same as Y′-3)



- Cross-linked DNA motifs for sequence-specific photo-responsiveness

Supplementary Table 10 Cross-linked DNA systems ($Y_i/L_0/Y_0$, i = 1x7, 3x5, 2x1x5)

Name	Sequence (5′–3′)
Y_i-1	(The same as Y_i-1, i = 1x7, 3x5, 2x1x5)
Y_i-2	(The same as Y_i-2, i = 1x7, 3x5, 2x1x5)
Y_i-2_FAM	[FAM]-CAACCACGCCTGTCCATTACTTCCGTCCTCACTG
Y_i-3	(The same as Y_i-3, i = 1x7, 3x5, 2x1x5)
Y_0-1	CTCGCGAGAAAGGAACTCTCCGCGTTGACAAAGCCGACACGT
Y_0-2	CTCGCGAGGCCTCTGTGTCGCATCTTCGCGGAGAGTTCCTTT
Y_0-2_Alexa405	[Alexa405]-GCCTCTGTGTCGCATCTTCGCGGAGAGTTCCTTT
Y_0-2_Cy3	[Cy3]-GCCTCTGTGTCGCATCTTCGCGGAGAGTTCCTTT
Y_0-3	CTCGCGAGACGTGTCGGCTTTGTCTTGATGCGACACAGAGGC
L_0-1	CTCGCGAGGCTGGACTAACGGAACGGTTAGTCAGGTATGCCAGCAC
L_0-2	CTCGCGAGCTCAGAGAGGTGACAGCATTCCGTTCCGTTAGTCCAGC
L_0-3	CTCGCGAGCCATGGTCCCAAGTGATGTTTGCTGTCACCTCTCTGAG
L_0-4	GCTCGAGCCGGCGCTGTAAATTTGCGTTCATCACTTGGGACCATGG
L_0-5	GCTCGAGCCAGACGTCACTCTCCAACTTCGCAAATTTACAGCGCCG
L_0-6	GCTCGAGCGTGCTGGCATACCTGACTTTGTTGGAGAGTGACGTCTG

- Plain Y motifs with redesigned SEs

Supplementary Table 11 rY_A

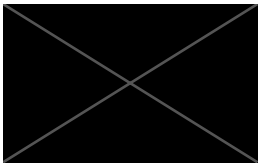
Name	Sequence (5′–3′)
rY_A-1	ATTATAAT...
rY_A-2	ATTATAAT...
rY_A-3	ATTATAAT...

The stem sequences (...) were the same as the counterparts of Y.

Supplementary Table 12 rY_B

Name	Sequence (5′–3′)
rY_B-1	TTCGAA...
rY_B-2	TTCGAA...
rY_B-3	TTCGAA...

The stem sequences (...) were the same as the counterparts of Y.



Supplementary Table 13 rY_C

Name	Sequence (5′–3′)
rY_C-1	**GATATATC**...
rY_C-2	**GATATATC**...
rY_C-3	**GATATATC**...

Supplementary Table 14 rY_D

Name	Sequence (5′–3′)
rY_D-1	**ACTTAAGT**...
rY_D-2	**ACTTAAGT**...
rY_D-3	**ACTTAAGT**...

Supplementary Table 15 rY_E

Name	Sequence (5′–3′)
rY_E-1	**GATCGATC**...
rY_E-2	**GATCGATC**...
rY_E-3	**GATCGATC**...

Supplementary Table 16 rY_F

Name	Sequence (5′–3′)
rY_F-1	**GACTCGAGTC**...
rY_F-2	**GACTCGAGTC**...
rY_F-3	**GACTCGAGTC**...

Sequences were referenced from Y. Sato *et al.* (2020).

Supplementary Table 17 rY_G

Name	Sequence (5′–3′)
rY_G-1	**GCTAGCGCTAGC**...
rY_G-2	**GCTAGCGCTAGC**...
rY_G-3	**GCTAGCGCTAGC**...

Sequences were referenced from Y. Sato *et al.* (2020).

- Cross-linked DNA motifs for cargo transport with directional motion

Supplementary Table 18 Cross-linked DNA system (Y_{2x4}/L'_0/Y_0)

Name	Sequence (5'–3')
Y_{2x4}-1,2,3	(See above)
Y_{2x4}-2_FAM	(The same as Y_i-2_FAM, *i* = 1x7, 3x5, 2x1x5)
Y_0-1,2,3; Y_0-2_Cy3	(See above)
L'_0-1,2,3	(The same as L_0-1,-2,-3, respectively)
L'_0-4	**GCTAGC**...
L'_0-5	**GCTAGC**...
L'_0-6	**GCTAGC**...

The stem sequences (...) were the same as the counterparts of L_0.